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THE WASPS OF THE GENUS *PLENOCULUS*
(HYMENOPTERA: SPHECIDAE, LARRINAE)

BY

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My study of these small wasps was begun many years ago and has extended, with interruptions, up to 1959. About 850 specimens of *Plenoculus* were assembled for study.

I wish to extend my thanks to the many entomologists and to the institutions with which they may be connected, for the very generous assistance given me. Mr. P. H. Timberlake, Associate Entomologist, Emeritus, University of California, Citrus Experiment Station, Department of Biological Control, Riverside, California, has made available the large collection of *Plenoculus*, which he obtained chiefly in southern California. A great deal of material, also from desert regions and elsewhere, has come from the collections of the California Insect Survey, Division of Entomology and Parasitology, University of California, at Berkeley, and the University of California at Davis, with Drs. P. D. Hurd and R. M. Bohart and their associates doing the collecting. Dr. George D. Butler, Jr., of the Department of Entomology, University of Arizona; Dr. Howard E. Evans, of the Department of Entomology, Cornell University; and Dr. R. R. Dreisbach, of Midland, Michigan, have likewise loaned considerable and interesting material. Dr. Herbert F. Schwarz, of the American Museum of Natural History, has donated several specimens of *Plenoculus*. Finally, Dr. Karl V.

Krombein, of the Division of Insect Identification and Parasite Introduction Laboratories, U. S. Department of Agriculture, Washington, D. C., has been unfailingly helpful in the loan of specimens, including the entire material of *Plenoculus davisi davisi* Fox from his own collection and also that from the collection of the U. S. National Museum. He has also compared specimens, and in his useful correspondence has made helpful suggestions and given references to pertinent literature. The excellent drawing of the head of *Plenoculus gillaspyi* Krombein (fig. 33) is the work of Mr. Arthur D. Cushman, of the U. S. National Museum. Through the courtesy of Dr. Krombein, I was able to study an important collection of *Plenoculus* and *Solierella* made by Dr. W. R. M. Mason in the Colorado and Mojave deserts. The author has also made collections of *Plenoculus*, chiefly in the Colorado desert. The collection of the California Academy of Sciences was also very helpful. The facilities made available by both the California Academy of Sciences, San Francisco, and the San Diego Society of Natural History Museum are here gratefully acknowledged.

In the Synoptic Catalog of Hymenoptera of America North of Mexico (Muesebeck, Krombein, Townes, and others, 1951, U.S.D.A. Monograph No. 2), and the first supplement to this Catalog for 1958, prepared under the direction of Dr. Krombein, a total of seven species and one subspecies are listed. In the Old World, two species have been described, one from Transcaaspiia, U.S.S.R. (as *Pavlovskia tadjhika* by Gussakovskij), the other from Portugal and Spain, by Andrade. In the present paper ten species and four subspecies of *Plenoculus* are described as new, while two forms of *Plenoculus* previously listed as valid are here regarded as mere color forms. This brings the total, as here accepted, to 17 species and 5 subspecies, as follows:

1. <i>Plenoculus sinuatus</i> , new species	Page 7
2. <i>Plenoculus gillaspyi</i> Krombein	" 8
3. <i>Plenoculus hurdi</i> , new species	" 10
4. <i>Plenoculus timberlakei</i> , new species	" 11
5. <i>Plenoculus cuneatus</i> , new species	" 12
6. <i>Plenoculus cockerellii</i> Fox	" 15
7. <i>Plenoculus mexicanus</i> , new species	" 17
8. <i>Plenoculus boregensis</i> , new species	" 20
8a. <i>Plenoculus boregensis perniger</i> , new subspecies	" 21
9. <i>Plenoculus parvus</i> Fox	" 22
10. <i>Plenoculus palmarum</i> , new species	" 22
11. <i>Plenoculus propinquus</i> Fox	" 25
12. <i>Plenoculus deserti</i> , new species	" 26
13. <i>Plenoculus boharti</i> , new species	" 28
14. <i>Plenoculus stygius</i> , new species	" 31
15. <i>Plenoculus davisi</i> Fox	" 32

15a. <i>Plenoculus davisi mojavensis</i> , new subspecies	Page 39
15b. <i>Plenoculus davisi transversus</i> , new subspecies	" 40
15c. <i>Plenoculus davisi gracilis</i> , new subspecies	" 42
15d. <i>Plenoculus davisi atlanticus</i> Viereck	" 43
16. <i>Plenoculus tadzhika</i> (Gussakovskij)	" 44
17. <i>Plenoculus beaumonti</i> Andrade	" 44

Genus **PLENOCULUS** Fox.

Plenoculus Fox, 1893. Psyche 6:554. Genotype *Plenoculus davisi* Fox.

Pavlovskia GUSSAKOVSKIJ, 1935. Trav. Fil. Acad. Sci. URSS, Tadzhikistan, 5:424.

Type: *Pavlovskia tadzhika* Gussakovskij. Monobasic and original designation.

Plenoculus may be characterized as follows: Mandibles distinctly emarginate on the lower side (59, 60), or more rarely they are stepped down from near the base so that there is little or no opposing elevation beyond (26A), with or without a tooth within just basad of the blade, malar space lacking or very short; maxillary palpi with six segments, labial palpi with four; the male with clypeal margin with or without a brush of rather incurved hairs far to each side; eyes entire within, converging toward the vertex; ocelli perfect; antennae originating immediately behind the clypeus. Prepectus tolerably well defined; legs stout, moderately to strongly spinose, female with a fore tarsal comb (80), weaker in the male, intermediate tibiae with a single apical spur; metasternum grooved; marginal cell truncate and rather weakly appendiculate; three submarginal cells, the second pedicellate, first and second submarginal cells each receiving a recurrent vein; submedian cell shorter than median on externo-median nervure; in the hind wings the discoidal vein originates well beyond the transverse-median vein; anal lobe short, not at all reaching to opposite apex of submedian cell. The pygidial area is subtriangular, shining and more or less punctate, the margins sharp or with a fine carina. Male with or without transverse tubercles or rugosities on sternites 3-6.

Plenoculus is separable from *Solierella*, its rather close relative, by a number of characters. In *Plenoculus* the mandibles are strongly excavate or, in fewer cases, stepped down beneath; in *Solierella* the mandibles are occasionally weakly excavate beneath, much less often they are strongly stepped down (*Solierella albipes* [Ashmead], *Solierella prosopidis* Williams); the female of *Plenoculus* has a good foretarsal comb which together with the stout, rather squat form of the wasp points to a fossorial habit, the bristles forming this comb being well developed on the long basal tarsal article; in some species of *Solierella*, particularly some of the larger ones, while they are not known to be fossorial, a tarsal comb of rather fine long bristles may exist, but these bristles do not occur strongly on the basal article of the foretarsus; *Plenoculus* has the more strongly spinose legs. As

far as known the members of the genus *Plenoculus* lack the strong frontal and clypeal carinae so often present in *Solierella*. An important separating character in *Plenoculus* is the well-defined pygidial area, particularly in the female, and in the male the lateral lobes of the aedeagus, while occasionally pointed on one side, are not dentate or serrate as is characteristic of *Solierella*.

The species of *Plenoculus* are broadly separated into two groups by Fox (1893, 1897) . . . "those having the clypeus strongly emarginate and dentate (*davisi*, *propinquus*), and those in which the clypeus is neither emarginate nor dentate (*cockerelli*, *parvus*¹)." However, the discovery in recent years of additional species including the males of the "*cockerelli*" group (*Pl. cockerelli*, *Pl. mexicanus*, *Pl. timberlakei*, and *Pl. cuneatus*), as well as the bringing to light of other species, i.e., *Pl. gillaspyi* Krombein (probably), *Pl. hurdi*, *Pl. sinuatus*, *Pl. boregensis*, and *Pl. palmarum*, and a restudy of *Pl. parvus* Fox, reveal that all of these forms possess one or more characters, in one or both sexes, that are common to these two original groups, tend to bridge the gap between them. On the other hand, the prey of *Plenoculus cockerelli*, as first discovered by P. H. Timberlake in southern California, consists of very small caterpillars, probably pyraloideans, and it is quite likely that the remaining three species of the "*cockerelli*" group also prey on caterpillars. As far as known, the species of the "*davisi-propinquus*" group (no prey records on *Pl. propinquus*) store their nests with small heteropterous bugs, and occasionally aphids.

This at least is a notable biological difference between these two *Plenoculus* groups.

Nothing seems to be known concerning the nature of the prey of the intermediate or more or less morphologically bridging group of *Plenoculus* species.

KEY TO THE SPECIES OF PLENOCULUS^{2, 3}

Females—antennae with 12 segments; abdomen with 6 tergites visible.....	1
Males—antennae with 13 segments; abdomen with 7 tergites visible.....	16
1. Anterior margin of the clypeus not produced in the middle, but sinuate, with one or two inconspicuous teeth far to each side (33, 35); mandible without a tooth on the inner margin (except in <i>Pl. sinuatus</i> where it is very small)	2
Anterior margin of the clypeus gently outbowed to cuneate in the middle, or the clypeus may be broadly subtruncate, or more sloping, emarginate mesad and with lateral teeth or angles	4

1. Dr. Karl V. Krombein has critically examined, with modern equipment, the type of *Plenoculus parvus* Fox (1897), female, and finds that it has two small teeth on each side of the clypeus. This species, which is related to my *Pl. palmarum*, thus belongs in an intermediate position.

2. The number in parentheses refers to figures in this paper.

3. This key has its difficult parts and is not entirely satisfactory. Some of the species considered are weak species.

- 2. Mandibles with a small basal notch or tooth on the inner margin; edge of clypeus broadly polished; red and white markings present.....
.....*Pl. sinuatus*, new species
- Mandibles without a basal tooth on the inner margin; edge of clypeus not broadly polished; red and white markings absent 3
- 3. Median emargination of the clypeus somewhat wider; distance between the inner margin of the antennal sockets much greater than the distance between the outer margin of the antennal sockets and the inner margin of the compound eyes at a point opposite, the ratio being approximately 3.5 to 2.2 (34)*Pl. hurdi*, new species
- Median emargination of the clypeus narrower, this emargination being partially filled by a thin transparent lamella; distance between the inner margin of the antennal sockets and between their outer margin and the opposing eyes nearly the same (33)*Pl. gillaspys* Krombein
- 4. Anterior margin of the clypeus outbowed or subconic, more rarely sharply conic; no median notch or emargination 5
- Anterior margin of the clypeus truncately or subtruncately produced and with a median notch or emargination 12
- 5. Clypeus gently outbowed, and toothed laterad; mandibles notched beneath (59, 60) and with an inner tooth 6
- Clypeus without teeth; mandibles more stepped-down near the base beneath than notched there (26A), and with no inner tooth 7
- 6. Clypeus with two teeth on either side; abdomen black except at tip.....
.....*Pl. parvus* Fox
- Clypeus with three teeth on either side; abdomen red
.....*Pl. palmarum*, new species
- 7. Clypeus gently outbowed, although slightly transverse apically (26), its color diluted white and reddish; pronotum with a creamy yellow tegumentary band; mid tarsi with rather long dense pale bristles (27); much silvery pile
.....*Pl. boregensis*, new species
- Clypeus reddish to black, gently outbowed or subconic in outline, more rarely pointed; pronotum without tegumentary band; mid-tarsal bristles brownish, stouter and shorter 8
- 8. Mandibles evenly, or very nearly evenly, curved (17, 22); pale leg markings present or absent 9
- Mandibles distinctly crooked or elbowed before the middle, this character is best seen in unworn specimens; pale leg markings present..... 10
- 9. Clypeal outline cuneate or wedge-shaped in its median portion; ocelli arranged in distinctly less than a right-angle triangle; pale leg markings present*Pl. cuneatus*, new species
- Clypeus gently outbowed; ocelli forming a triangle at least as great as a right-angle triangle; pale markings absent.....*Pl. timberlakei*, new species
- 10. Clypeus gently outbowed, cuneate, or more rarely sharply conic; pale femoral marks present 11
- 11. Clypeus gently outbowed to conic; mandibles moderately slender. Southwest United States; Baja California and Guerrero, Mexico.....*Pl. cockerellii* Fox
- Clypeus subconic, sometimes with an inconspicuous ridge; mandibles very slender (13). Tropical Mexico, E. and W.*Pl. mexicanus*, new species
- 12. Anterior margin of the clypeus deeply incised mesad, and depressed about this incision, the sides of which are more or less rounded to the first angle or tooth, of which there are three (55, 85) 13

- Clypeus less deeply incised mesad, little or not depressed there and with two to five teeth on each side of the median incision (54, 62, 63, 67)..... 14
13. Generally larger species, up to 6-7 mm. long; abdomen black or red and black; the disc of the pygidium dark and smooth and hardly affected by its punctuations. Distribution: From the Rocky Mountains to the Pacific Coast *Pl. propinquus* Fox
Smaller, to about 5 mm.; abdomen red; disc of pygidium roughened by its heavy punctation. Colorado Desert *Pl. deserti*, new species
14. Clypeus generally with four strongly developed teeth on each side of the rather narrow median emargination; abdomen red with increasingly large black marks from base to apex (84). California, chiefly in the Upper Sonoran Zone *Pl. boharti*, new species
Clypeal margin with from two to five teeth on each side of the median incision, but sometimes these teeth are largely reduced to mere crenulations (67, 69); abdomen usually without the color pattern as described above, or the abdomen is black 15
15. Clypeal dentition delicate, of three or four teeth on each side of the median notch; truncation of the marginal cell usually quite narrow (5). A small highly polished black, or more rarely with the abdomen red, species with no clear yellow markings. Colorado Desert, California; Picacho Pass, Pinal County, Arizona *Pl. stygius*, new species
Clypeal dentition normally of four teeth on each side of the median notch, but it may be variable; abdomen more commonly black
..... *Pl. davisi* and subspecies
16. Sternites 3-6 smooth; clypeus without a hair brush on either side (14A, 23) 17
Sternites 3-6 more or less transversely tuberculate, or at least the area is gently undulate; clypeus produced subtruncate mesad, with a hair brush on either side (43, 44, 56) 23
17. Mandibles with a tooth within; clypeus subtruncate (37) 18
Mandibles without a tooth within, or the tooth is very small and placed on a ridge posterior to the blade (31); clypeus rounded out to subcuneate in the middle 19
18. Inner tooth of mandibles strong; article 13 of antennae not gently curved; uncal lobes slightly acuminate on the ventral side but with a tuft of bristles near their apex (71) *Pl. palmarum*, new species
Inner side of mandibles with a moderate tooth at the base of the blade (30); article 13 of the antennae gently curved; uncal lobes without a tuft of bristles near the apex; produced portion of clypeus truncate.....
..... *Pl. sinuatus*, new species
19. Clypeus produced mesad as a low, evenly rounded lobe (28); articles 3 and 4 of the antennae subsequal; uncal lobes acuminate ventrad in profile (29B)
..... *Pl. boregensis*, new species
Clypeus a little more strongly produced mesad; uncal lobes as viewed from above strongly conelike in profile (72) 20
20. Clypeus rather narrowly produced mesad, where it is cuneate, with a lateral extension from its depressed sides (20); seventh antennal segment lobed apically on the outer side and provided with one or more longer hairs (21)
..... *Pl. timberlakei*, new species
Clypeus without a lateral extension from depressed sides; antennae without modification 21

21. Produced portion of the clypeus narrowly subtruncate mesad, a tooth at either side of the thin margin (24, 25); antennae rather stout, not slender at the base, article 3 not longer than 4.....*Pl. cuneatus*, new species
Clypeus without teeth, gently rounded out subcuneate; antennae rather slender basad, article 3 slightly longer than 4 22
22. Clypeus not carinate (14A)*Pl. cockerellii* Fox
Clypeus delicately carinate; mandibles more slender than in *Pl. cockerellii* (23)*Pl. mexicanus*, new species
23. Scape of the antennae almost always dark concolorous; clypeus very rarely clear yellow 24
Scape pale beneath; clypeus commonly clear yellow (dull yellow in *Pl. stygius*) 26
24. Clypeus blackish; margin of the produced portion multidentate (61, A and B); volsellar armature feeble*P. boharti*, new species
Clypeus mesad dull yellowish or yellowish red, the base often black, more rarely it is all black, this produced portion often somewhat depressed for the apical portion, which may be gently bilobed; volsella usually with some strong spines or teeth 25
25. Larger; clypeus generally dirty yellow; abdomen black or black and red; volsella with 2-3 short stout thorns (81, 82).....*Pl. propinquus* Fox
Smaller; clypeus dark or blackish; abdomen orange red; volsella with about 8 strong spines. Colorado Desert, California*Pl. deserti*, new species
26. Polished black; the pale markings are dull yellow to pale yellowish brown; volsellar ridge with about 5 stout bristles (90). A desert species.....
.....*Pl. stygius*, new species
Abdomen black, black and red or entirely red; pale markings almost always creamy yellow; volsella generally with inconspicuous bristles. Widely distributed and variable*Pl. davisii* Fox, and subspecies

***Plenoculus sinuatus* Williams, new species.**

(Figures 30, 32, 35.)

FEMALE, holotype. Length, 5.25 mm. Black; head and thorax subopaque, abdomen rather shining; clypeus apically, mandibles except apex, scape beneath at apex, tarsi, and abdomen reddish; pronotal lobes, tegulae basad and basal wing sclerites, femora 1 and 2 in part beneath to apex, and tibiae 2 and 3 in part creamy white, femora 3 at apex and tibiae 2 and 3 with some reddish brown. Head relatively wide; clypeus very short, its margin sinuate, being shallowly emarginate mesad where it is polished, broadly and steeply developed and with a very few large punctures, while posterior to this emargination it is transversely tumid, and there is a small clypeal tooth near the inner base of the mandibles; mandibles slender, crooked, provided with rather long, sparse, erect hairs, well emarginate beneath, and within with a small tooth at the base of the blade; antennae moderately stout, article 3 slightly longer than 4, 12 more curved on one side, and tapering, with articles 10, 11, and 12 slightly reddish on the underside; ocelli forming slightly more than a right-angle triangle, interocellar line less than the postocellar line.

Punctuation of dorsulum fine, subcoriaceous, bristles of fore tarsal comb as long as to longer than the segments from which they arise. Disc of propodeum a rather broad, mainly coriaceous triangle, rounded apically, the pleurae with fine oblique striae, the posterior face with a grooved depression in its upper two-thirds. Spurs and leg bristles generally pale brown, venation pale testaceous. Marginal cell not broadly truncate, somewhat exceeding the third submarginal cell. Pygidium rather narrowly triangular, narrower than usual at apex, polished, with sparse larger and smaller punctures, the sides slightly constricted preapically. Vestiture white pile, dense on face, portions of thorax and bordering the disc of the propodeum, silvery abdominal bands not conspicuous.

MALE, allotype. Length, 4.25 mm. Marked much like the female, but the clypeus is entirely blackish, the last antennal segment rather contrastingly brownish, and the generally red abdomen dark apically; the creamy white tibial stripes are distinct and the scape all dark. The disc of the clypeus is slightly convex, its margin slightly rounded truncate, its shoulders strong, and there are no lateral hair tufts; the mandibles with a moderate tooth within; antennae moderately stout, article 2 (Pedicel) less than one and one-half times as long as thick; 3 longer than 4, 13 gently curved and about as long as 11 plus 12; ocelli in about a right-angle triangle. Mesopleurae with a small ventral tubercle. Abdominal venter smooth. Terminalia with the aedeagal lobes pointed ventrad, much as in *Pl. boregensis*, but differs from that species in having a group of three bristles below the middle of the parameres (32).

HOLOTYPE, female. In fresh condition, Borego, San Diego County, California, April 27, 1954 (P. D. Hurd). ALLOTYPE, male, topotypical, May 13, 1954 (F. X. Williams), on low *Euphorbia*. PARATYPES, 1 female, Palm Springs, Riverside County, California, July 29, 1952 (P. H. Timberlake), on *Eriogonum trichopes*; 1 male, Borego, April 27, 1954 (P. D. Hurd); 1 female, 3 miles north of Scissor's Crossing, San Diego County, IX, 8, 1955 (J. C. Hall). The male paratype has the clypeus partly reddish.

DISCUSSION. This species is readily separated from the next two species by means of the table and illustrations.

Plenoculus gillaspyi Krombein.

(Figure 33.)⁴

Plenoculus gillaspyi KROMBEIN, 1938. Ent. Soc. Amer. An. 31:468. Female. Round River, Williamson County, Texas, October 10, 1935, on *Baccharis salicina*. (J. E. Gillaspay.)

4. Drawn by Arthur D. Cushman.

This species, of which there is but one specimen known, was taken at what is apparently the western edge of the Lower Humid Austral Zone. It measures 4.70 mm. long. Except for the red apically on the mandibles and tegulae, it is all black. The sculpture is quite fine; the clypeus is very short (i.e., from base to anterior edge), being emarginate in the middle. The distance between the inner margin of the antennal sockets is equal

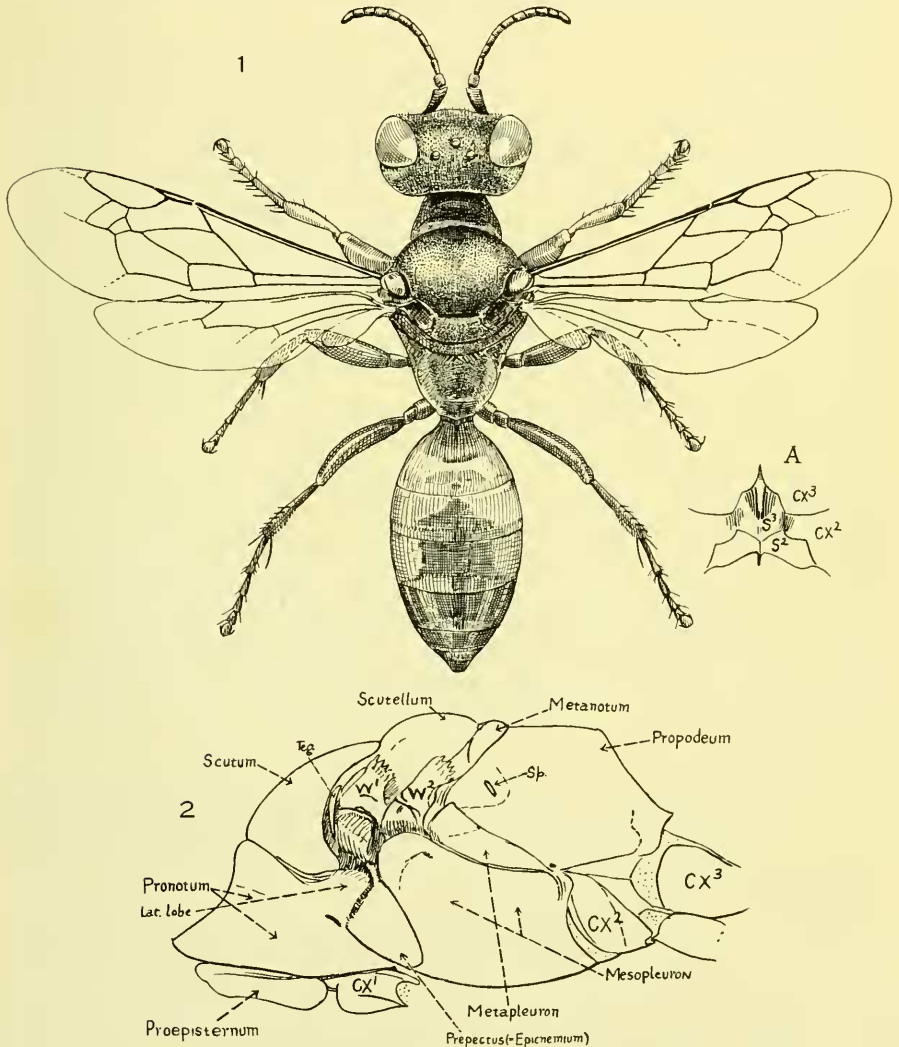


Figure 1. *Plenoculus propinquus*. Female. Length 6.2 mm. From Riverside, California. At A, thoracic sternites 2 and 3 of a male from Nevada.

Figure 2. *Plenoculus timberlakei*. Female. Thorax, from side. From five miles south of Palm Springs, California.

to the distance between the inner margin of the compound eye and the outer margin of the antennal sockets.

DISCUSSION. Obviously, this species is rather closely related to *Pl. hurdi*, new species.

Plenoculus hurdi Williams, new species.

(Figure 34).

FEMALE, holotype. Length, 4.75 mm. Head and thorax subshining, abdomen shining, sculpture very fine. Black; there are no pale markings, the mandibles are nearly uniformly black, the tibial spurs pale, the tarsi nearly black, the venation blackish brown, and the apex of tergites 1-3 very narrowly testaceous. The head is wide, chiefly finely reticulate or coriaceous and the preoccipital carina rather narrowly obsolete dorsad. The clypeus is short, and the anterior margin sinuate and is strongly tumid, rounded and polished along the shallow median emargination, and has an inconspicuous tooth over the base of the mandibles. The mandibles are quite slender, somewhat crooked before their middle length, broadly excavate beneath and with no inner tooth; the antennae are moderately stout, the flagellum subfusiform, articles 3 and 4 subequal; the ocelli in somewhat less than a right-angle triangle. The disc of the propodeum rounded, very finely reticulate, its median trough shallow, commencing well beyond the base, not infringed upon by silvery pile, its pleurae coriaceous, the posterior face with some transverse striae and a narrow median cleft expanding toward the dorsum. Tarsal comb bristles shorter than the diameter of the segments from which they arise. Abdomen generally very finely reticulate. The disc of the pygidium is entirely black, polished and with moderately fine punctures, it is rather narrow with the sides nearly straight. Vestiture: The moderate silvery pile has evidently been obscured by the effects of moisture.

HOLOTYPE, female. In unworn condition, Teotihuacan Pyramid, Mexico, July 6, 1951 (P. D. Hurd). PARATYPE, 1 female, also in fine condition (collection, University of California at Davis), Teotihuacan, Mexico, July 21, 1956 (Rand and K. Dreisbach).

DISCUSSION. This species is most nearly related to *Pl. gillaspyi* Krombein described from Round River, Williamson County, Texas. It differs from *Pl. gillaspyi* in its wider clypeal emargination, and in the fact that the distance between the inner margin of the antennal sockets is much greater than the distance between the outer margin of the antennal sockets and the inner margin of the compound eye, the ratio being approximately 3.5 to 2.2, or a coefficient of 6.29.

Named for Dr. Paul D. Hurd of the Department of Entomology, Uni-

versity of California, Berkeley, who with his fellow entomologists has collected so much material in this genus of wasps.

Unfortunately, the labrum of the holotype was damaged through my dissection, but in the paratype, the labrum shows as a dark brownish, almost opaque hair-fringed strip that is closely appressed to or fused with, the clypeus and stretches inconspicuously across its median emargination.

***Plenoculus timberlakei* Williams, new species.**

(Figures 2, 11, 19-22, 31, 38, 47, 49, 52, 77.)

FEMALE, holotype. Length, 6 mm. Shining except disc of propodeum. Black, mandibles reddish beyond base to near apex, antennae from apex of scape onwards, brownish, all tibiae reddish apically with yellow base, tegulae transparent testaceous, bases of principal veins more or less creamy yellow, spines honey yellow, abdomen red. Frons coriaceous, vertex finely punctate; clypeus evenly rounded out mesad; mandibles evenly curved, with a notch or step-down beneath near base; antennae short, subclavate, article 3 longer than 4; ocelli in slightly more than a right-angle triangle; preoccipital carina interrupted dorsad; scutum and scutellum with rather fine separate punctures, postscutellum more finely and closely punctured, mesopleurae with some fine obscure wrinkles posteriorly. Disc of propodeum coriaceous, with fanning basal carinulae and a shallow, more or less cross-carinate median groove, the pleurae generally polished and with some carinulae and punctures, posterior face polished, with a narrow obconic groove and a few transverse carinulae. Tibiae and tarsi, except for the more lightly armed fore tibiae, with rather numerous short stout bristles. Tergite 5 with strong well-spaced punctures. Pygidium well margined, the disc sparsely punctured and somewhat constricted subspatulate apically. Vestiture: rather sparse silvery pile, the specimen being rather worn.

MALE, allotype. Length, 3.8 mm. Head and thorax rather densely clothed with silvery pile; abdomen banded with silvery pile. Black; clypeus except base of produced portion and most of the sides, mandibles except apex, fore femora beneath except at base, all tibiae except in part beneath, pale yellow to brownish yellow; tegulae translucent, base of wings more or less creamy; antennae yellowish brown, excepting the first 6-7 segments above; abdomen reddish. Clypeus rather narrowly produced mesad, apically cuneate, the area at the base of this production is well depressed and gives rise on each side to a short outcurved process upon which the mandibles when folded seem to rest. Mandibles without inner tooth in line with the blade. Antennae stout, fusiform-clavate, the pedicel constricted basally, article 7 lobed apically on outer side above and provided with one longer and several shorter hairs, shorter hairs being present also on 2-6; preoccipital carina interrupted dor-

sad. Disc of propodeum opaque, with fanning basal and some transverse carinulae, no obvious median groove, but there is a slightly depressed area at apex of the disc; pleurae opaque, with fine carinulae; posterior face with transverse carinulae and a median incision that widens dorsad. Second submarginal cell with a short petiole. Abdomen finely punctate, not tuberculate beneath. Aedeagus as in *Pl. cockerelli*.

HOLOTYPE and ALLOTYPE (Citrus Experiment Station, Riverside): holotype, 5 miles south of Palm Springs, California, June 28, 1941, on *Dalea spinosa*; allotype, Beaver Dam, Arizona, June 20, 1939, on *Eriogonum trichopodum*; PARATYPES, 2 females, Beaver Dam, Arizona, June 20, 1939, on *Eriogonum trichopodum*; 2 males, 6 miles south of Palm Springs, Colorado Desert, California, June 8, 1930, on *Eriogonum trichopodum*; 2 females, 4 miles south of Palm Springs, June 25, 1941, on *Dalea spinosa*. Not considered a paratype is a female dissected for study and bearing the label: 6 miles south of Palm Springs, Colorado Desert, California, June 8, 1930. All these specimens were collected by P. H. Timberlake. Not considered paratypes are 2 females, Palm Springs, June 25 and 28, 1941 (E. C. Van Dyke).

DISCUSSION. In the female the evenly curved mandibles, the pygidium somewhat spatulate at tip and the lack of pale femoral markings will serve to distinguish *Pl. timberlakei* from *Pl. cockerelli*, while the curiously developed clypeus and the somewhat modified antennae will serve that purpose in the male.

Plenoculus cuneatus Williams, new species.

(Figures 10, 17, 18, 24, 25.)

FEMALE, holotype. Length, 4.5 mm. Shining, except disc of propodeum. Black; rim of median portion of clypeus, mandibles except at darker base, and apex of scape narrowly beneath, dull reddish brown; tibiae and tarsi in part reddish; antennae dull brownish beneath, the apical segment a little paler; tegulae and basal portion of wings, particularly along the costa, prothoracic lobes apically, fore femora for apical half beneath, a small spot apically on intermediate femora, the very tip of hind femora, and all tibiae above, largely creamy yellow; abdomen all red. Sculpture of head and thorax largely obscured by the generous silvery pile. The frons evidently coriaceous

Figure 3. *Plenoculus cuneatus*. Male. To show part of the venation of the forewing. From Glendale, Nevada.

Figure 4. *Plenoculus cockerelli* ?. Male. From Tucson, Arizona.

Figure 5. *Plenoculus stygius*. Female, holotype. From Palm Springs, California.

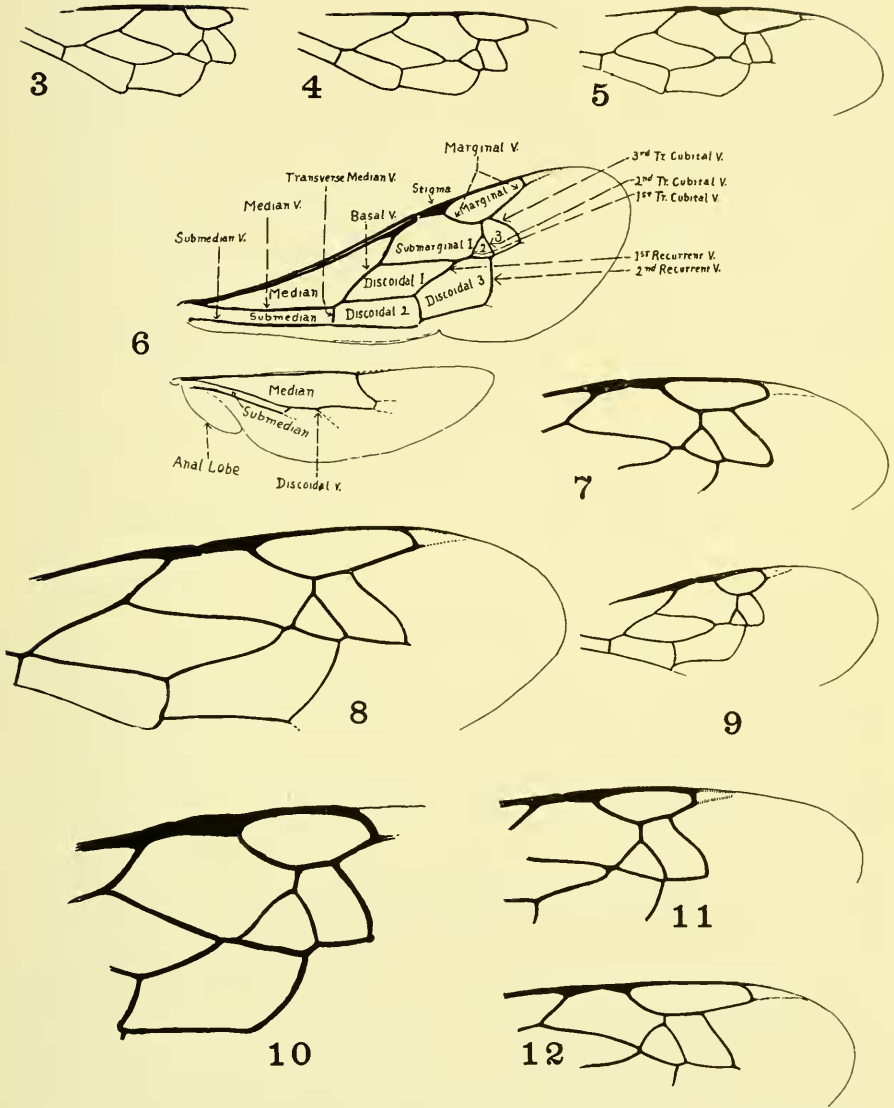


Figure 6. *Plenoculus davisi* (= *P. apicalis*). Male, type series. From Northwest-ern Kansas.

Figure 7. *Plenoculus davisi*. Male. From Gavilan, California.

Figure 8. *Plenoculus davisi transversus*. Female. Holotype. From Tulare County, California.

Figure 9. *Plenoculus palmarum*. Male. From Palm Springs, California.

Figure 10. *Plenoculus cuneatus*. Holotype. Female. From Imperial County, Calif.

Figure 11. *Plenoculus timberlakei*. Female. From near Palm Springs, California.

Figure 12. *Plenoculus davisi*. Probably a female. From Morongo Valley, Calif.

or granular. Clypeus with the well-bossed median portion chiefly shining, curving into its cuneate and well-rimmed extension; mandibles almost evenly curved, rather broadly notched beneath; antennae short, subclavate, article 3 longer than 4, article 12 subeonic; ocelli forming a triangle intermediate between an equilateral and a right-angle triangle; preoccipital carina complete dorsad. Scutum and scutellum strongly and closely punctate. Disc of propodeum rather closely hedged by dense silvery pile, the median line delicate and interrupted, the pleurae reticulate-striate, the posterior face subopaque and with a shallow median area. Comb of the basal article of the foretarsus consisting five bristles which are nearly twice as long as the diameter of this basal article. Other leg bristles moderate. Marginal cell of forewings somewhat shorter than usual in the female, and its apex is broadly and obliquely subtruncate and extending apically fully as far as does the third submarginal cell. The third transverse-cubital vein is outbowed and not sinuate. Abdomen broad, the tergites shining, the tergites 1-4 very fine, chiefly hair punctured, the usual large scattered punctures on tergite 5, the 6th tergite (pygidium) widely triangular, slightly constricted apically and provided with large scattered punctures, the bounding carinae low, hardly raised. The apices of tergites narrowly and obscurely pale yellowish, that of tergite 1 rather strongly banded by silvery pile.

MALE, allotype. Length, 4 mm. somewhat less shining than the female. Markings about as in the female, except that the disc of the clypeus almost entirely, the mandibles basally, the scape beneath and the legs to a greater degree, are creamy yellow. The antennae have the first three articles dark brown above, becoming much lighter for the last ten articles, and beneath articles 2 and 3 are dark, and all the remainder lighter than above. The venation generally, testaceous and the abdomen all red. The clypeus is not carinate, its median portion is moderately bossed, drawn out mesad, and with a tooth before its rather narrowly truncate apex. The clypeal margin is wide and rather bristly for its lower sides. Mandibles well notched beneath, almost evenly curved, not toothed within. Antennae stout and subclavate, viewed dorsally article 3 is very little longer than 4 and narrower than the subquadrate pedicel (article 2), the pedicel however, as viewed from the side is subtriangular, but constricted basally; from the side the basal articles trend obliquely, and all the flagellum except articles 12 and 13 are rounded out below with a total erenulate effect. Article 13 is tapering and nearly as long as 11 plus 12. Ocelli in very slightly more than an equilateral triangle. Preoccipital carina complete dorsad. Disc of propodeum subopaque, finely reticulate, a short median carina and an apical depression, the disc hedged by silvery pile. Marginal cell short, the third submarginal cell extending about equally toward apex of wing. Tergites with fine dense punctures, with silvery pile bands on apices of 1-4; tergites 6 and 7 with quite sparse larger

punctures. Terminalia of the *Pl. cockerellii* type. No examination was made of the terminalia of the allotype of *Pl. cuneatus*.

HOLOTYPE, female, and ALLOTYPE, male, from Pinto Wash, Imperial County, California, May 5, 1958 (F. X. Williams), on *Euphorbia polycarpa* var. *hirtella*. PARATYPE: 2 females and 3 males, same data as type material. Specimens not considered paratypes: 1 male, Thousand Palms, Riverside County, California, April 23, 1955 (W. R. M. Mason); 1 male, Borego, San Diego County, April 25, 1954 (P. D. Hurd), on *Croton californicus*, and 1 male in the U. S. National Museum (No. 1119, B 29), from Glendale, Nevada, October 3, 1929, on *Chrysothamnus paniculatus*, and collected by David E. Fox.

DISCUSSION. This distinct species is readily separated from *Pl. timberlakei*, its nearest relative, in the female by its euneate clypeal margin, the narrower ocellar triangle, the generally shorter marginal cell and the presence of femoral and tibial markings; the male of *Pl. cuneatus* is differentiated by the form of the clypeus and the unmodified antennae.

***Plenoculus cockerellii* Fox.**

(Figures 4, 14, 15, 16, 42, 48, 50, 51, 70, 80.)

Plenoculus cockerellii Fox, 1893, Proc. Acad. Nat. Sci. Phila., 45:538. Female. Las Cruces, New Mexico (T. D. A. Cockerell).

FEMALE. *Plenoculus cockerellii*, as represented by a specimen in the U. S. National Museum, and taken in the type locality in 1928, by Cockerell, is about 6 mm. long. It is black with the clypeus and mandibles largely reddish, the antennae brownish with the apex of the last article paler, the first and second femora with pale creamy white apically beneath, the legs are generally darker and lighter reddish, and the abdomen red. The clypeus is evenly rounded out, the antennae rather short and subelavate, article 3 plainly longer than 4; the ocelli form about a right-angle triangle, and the preoccipital carina is entire above; the tibial spines are moderate; tergite 5 is without large deep punctations; the pygidium is very little constricted before the apex, the disc of which is evenly flattened. The punctation is fine, or the sculpture largely coriaceous.

MALE (hitherto undescribed). Subopaque. It is black with the clypeus and mandibles, except their apex and lower tooth, brownish yellow, the antennae with the scape beneath lemon yellow, articles 3-6 dull yellowish beneath, the last articles being honey yellow; the margin of the prothoracic lobes and the base of the wings are creamy yellow, the tegulae are in part translucent, the rest creamy yellow; most of the fore femora beneath and the apex of all the femora, tibiae, except a stripe beneath, and the tarsi,

creamy yellow; the abdomen is reddish, obscurely black above and beneath at middle length. The clypeus is rounded out, slightly wedge-like mesad, with a slightly prominent translucent rim (the clypeus and mandibles are somewhat worn down); mandibles slightly elbowed, not dentate within; antennae rather slender for the basal part of the flagellum, articles 3 and 4 subequal from above; ocelli forming very slightly more than a right-angle triangle; vertex finely granulate, preoccipital carina entire dorsad; thoracic notum finely and closely punctate; disc of propodeum finely granulate and with a shallow trough that has some transverse striae, the pleurae in part smooth and in part finely striate, the posterior face shining and with a triangular depression above. Vestiture is of silvery pile forming bands on the abdomen. Terminalia with the lobes of the aedeagus, as seen from above, extending cone-like laterally.

This description of the male is based on somewhat worn specimens from: Four miles east of Eden, Riverside, California (P. H. Timberlake). Males from La Paz, Baja California, Mexico, are much darker. And intermediates occur elsewhere.

SPECIMENS STUDIED: ARIZONA—COCHISE COUNTY: 17 miles east of Douglas, 2 females, August 8, 1958 (R. M. Bohart); Willcox, 2 males, 1 female, August 14, 1958 (D. D. Linsdale); Madera Canyon, Santa Rita Mts., 1 female, July 31, 1958 (R. M. Bohart). GRAHAM COUNTY: San Carlos, 1 female, July 15, 1955 (N. J. Nerney), swept/1 alfalfa. MARICOPA COUNTY: Wickenburg, 1 female, August 25, 1927 (Cornell Univ., Lot 542, sub. 334). PIMA COUNTY: Sabino Canyon, 1 female, July 17, 1954 (R. M. Bohart). Tucson, 1 male, May 30, 1920 (F. X. Williams, doubtfully this species); 10 females and 1 male, July 17, 1955 (G. D. Butler), *Wislezania*. PINAL COUNTY: Eloy, 10 miles south, 1 female, July 3, 1953 (T. R. Haig). CALIFORNIA—RIVERSIDE COUNTY: Cathedral City, 1 female, October 8, 1946 (P. H. Timberlake), on *Euphorbia polycarpa*. Four miles east of Eden, 2 males, April 17, 1937 (P. H. Timberlake), on *Eriogonum thomasi*. Palm Springs, 3 females, June 24, 29, 1954 (P. H. Timberlake), on *Dulca spinosa*. Twenty-nine Palms, 1 female, August 9, 1946 (P. H. Timberlake), on *Wislezania refracta*; one female (carrying a pyralid caterpillar), September 5, 1946 (P. H. Timberlake). Thousand Palms, 2 males, April 16 and 23, 1955 (W. R. M. Mason). SAN DIEGO COUNTY: Borego Desert, 1 female, April 27, 1954 (P. D. Hurd); 1 female, April 27, 1954 (M. Wasbauer), on *Croton californicus*; 1 female, May 26, 1954 (F. X. Williams), 1 female, April 27, 1955 (R. O. Schuster). NEW MEXICO—DONA ANA COUNTY: Las Cruces: 3 females, August, 1928 (Cockerell) (Ckll. 4870 and Ckll. 4877, Collection U. S. National Museum). Albuquerque (desert), 5 males, June 15, 1956 (R. and K. Dreisbach). HIDALGO COUNTY: Rodeo, 2 females, August 21, 26, 1958 (R. M. Bohart); 18 miles north of Rodeo, 7 females, August 19, 25,

and 26, 1958 (R. M. Bohart). TEXAS—EL PASO COUNTY: El Paso, 1 female, July 24, 1914 (J. C. Bradley), Cornell U. Lot 684, sub. 35 (labeled, *Plenoculus cockerelli* Fox ♀, J. C. Bradley, 1923. Comp. with type). LLANO COUNTY: Not far from Austin, 1 female, June 12, 1941 (J. E. Gillaspay) Col. Univ. Calif., Berkeley). MEXICO—BAJA CALIFORNIA: La Paz, 1 female, October 12, 1954 (F. X. Williams); 33 females and 4 males, October 8, 1955 (F. X. Williams). GUERRERO: Mexcala, 1 female, June 29, 1951 (P. D. Hurd).

DISCUSSION. Easily separated from *Pl. timberlakei* by its elbowed mandibles, this character being more obvious in the female, and by the unmodified clypeus and antennae in the male. However, *Pl. cockerelli* shows considerable variation over its wide range. A female from Las Cruces, New Mexico, has a good deal of reddish about the mandibles, clypeus and femora; those from La Paz, Baja California, are considerably darker, with some of the California examples intermediate between the two. The pale femoral markings seem always present. The female from Llano County, Texas, and several from Arizona (Cochise, Graham, and Pima counties) have the clypeus drawn out wedge shaped (figs. 15, 16). Males may be quite dark, and in material from the same locality and collected on the same date one specimen has the clypeus quite black while another may have the clypeus of an old ivory color. Sometimes the clypeus shows a weak median ridge, as in the five males from Albuquerque, while a male from Tucson has the mandibles narrowly cleft within.

***Plenoculus mexicanus* Williams, new species.**

(Figures 13, 23.)

FEMALE, holotype. Length, 5.5 mm. Black; vertex and dorsulum shining, disc of propodeum subopaque. Clypeus narrowly reddish margined, mandibles red, darker apically, scape black and obscure reddish, pronotal lobes dull reddish, the first and second pair of femora with a creamy yellow stripe beneath, tibiae and tarsi mainly reddish brown; abdomen red, with much blackish apically up to the second tergite; pygidium dark red. Head wider than high; clypeus with the median portion rather gibbous and drawn out subcuneate, with scattered punctures except rather narrowly mesad, thus giving it a subcarinate aspect; mandibles very slender, distinctly elbowed at the basal third, feebly and widely excavate beneath, the bordering notch low, no inner tooth, the blade being quite low and forming in profile only a gentle convexity; antennae stout, article 3 longer than 4; ocelli arranged in about a right-angle triangle; preoccipital carina complete dorsad but not reaching the gular suture below. Dorsulum very closely punctate; disc of propodeum finely and transversely aciculate, narrowly depressed apically,

posterior face with a narrow wedge-like depression; marginal and submarginal cells extending equally apically. Fifth tergite with the usual large punctures; pygidium slightly compressed subapically, with a few strong punctures. Pile silvery.

MALE, allotype. Length, 4 mm. Head, thorax, except the largely creamy yellow pronotal lobes, and the abdomen, except a little reddish laterally at the base, black. Clypeus red apically, mandibles creamy yellow basad, reddish apically; scape beneath and the last five or six articles increasingly brownish; tegulae and axillary sclerites pale yellowish brown; first and second pairs of femora beneath from apex, all tibiae widely above, and the tarsi, creamy yellow. Clypeus rounded subcuneate mesad, with a fine low, more or less divided carina; mandibles slender and elbowed, though less so than in the female, well excavated beneath; antennae fusiform, slender at the base, articles 3 and 4 subequal, article 13 tapering; ocelli forming less than a right-angle triangle. Dorsulum and disc of the propodeum nearly opaque. Terminalia of the *Pl. cockerellii* type. Vestiture of silvery pile, forming bands on the abdomen.

HOLOTYPE, female, and ALLOTYPE male, from Acapulco, State of Guerrero, Mexico, July 1, 1951 (H. E. Evans). PARATYPES, all from Mexico, as follows: 5 females from Acapulco, date as above; 1 female, Tecolutla, State of Veracruz, June 19, 1951 (H. E. Evans); 4 females and 1 male from Veracruz, June 20, 1951 (H. E. Evans); 1 male and 16 females, Acapulco, July 1, 1951 (P. D. Hurd); 16 females, Veracruz, June 20, 1951 (P. D. Hurd); 3 females, Tecolutla, June 19, 1951 (P. D. Hurd), and 1 male, Alpuyecá, Morelos, Mexico, July 3, 1951 (P. D. Hurd).

DISCUSSION. *Plenoculus mexicanus* differs consistently from *Pl. cockerellii* in its more slender and more crooked mandibles, particularly in the female. In the male of *Pl. mexicanus*, of which sex only four specimens have been collected, the abdomen may be almost entirely black.

Figure 13. *Plenoculus mexicanus*. Female. Holotype. Jaws and clypeus. From Acapulco, Mexico.

Figure 14. *Plenoculus cockerellii*. Female. From La Paz, Baja California, Mexico. At A, clypeus of male. Same locality.

Figure 15. *Plenoculus cockerellii*. Female. From Llano County, Texas.

Figure 16. *Plenoculus cockerellii*. Female. From Tucson, Arizona.

Figure 17. *Plenoculus cuneatus*. Female. Holotype. From Imperial County, Calif.

Figure 18. *Plenoculus cuneatus*. Female. Holotype. Ocellar triangle.

Figure 19. *Plenoculus timberlakei*. Female. Holotype. Five miles south of Palm Springs, Riverside County, California.

Figure 20. *Plenoculus timberlakei*. Male. Beaver Dam, Arizona.

Figure 21. *Plenoculus timberlakei*. Male. Antenna from side.

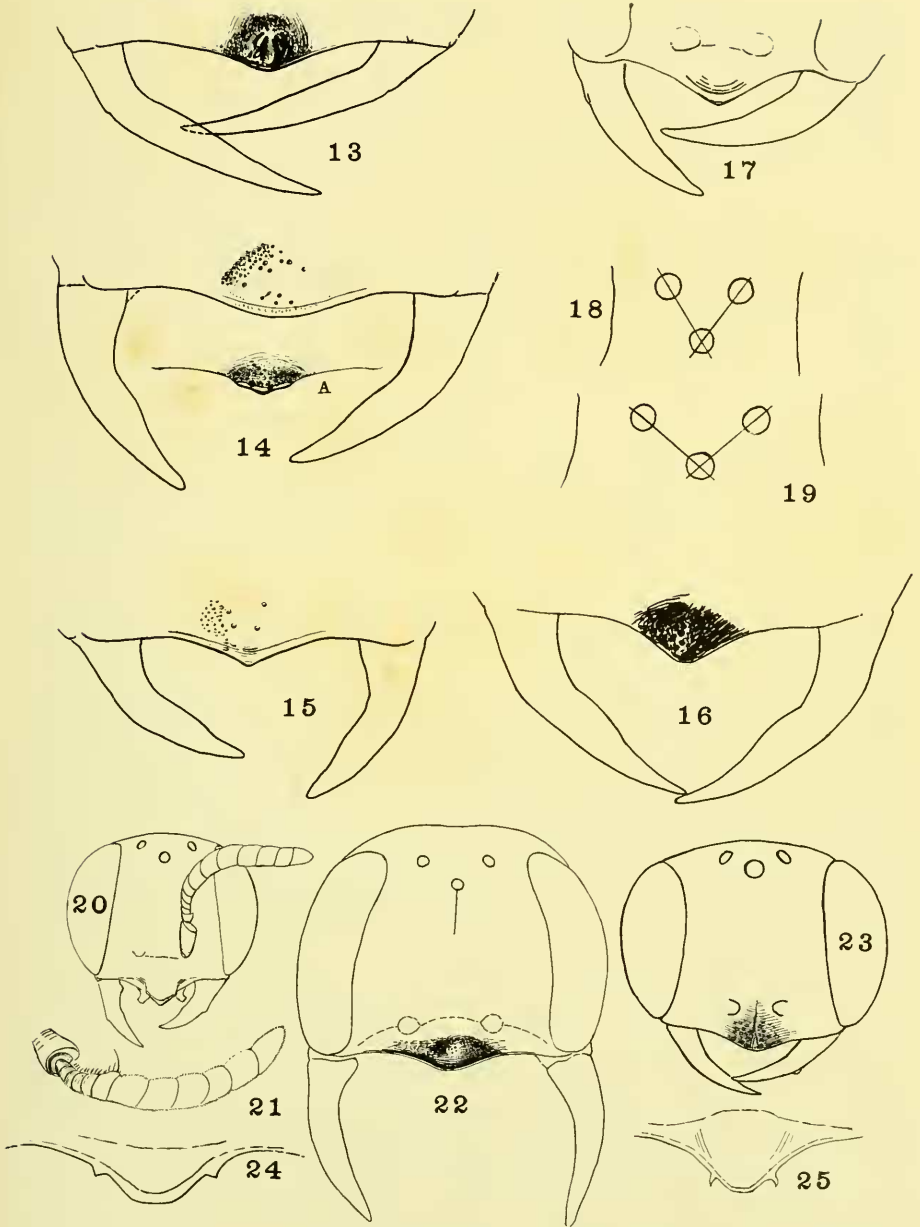


Figure 22. *Plenoculus timberlakei*. Female. From near Palm Springs.
 Figure 23. *Plenoculus mericanus*. Male. Allotype. From Acapulco, Mexico.
 Figure 24. *Plenoculus cuneatus*. Male. Clypeus. From Glendale, Nevada.
 Figure 25. *Plenoculus cuneatus*. Male. From Borego, San Diego County, Calif.

Plenoculus boregensis Williams, new species.

(Figures 26, 27, 28, 29.)

FEMALE, holotype. Length, 6 mm. Black; clypeus diluted white, its margin narrowly, except wedge-like mesad, reddish; mandibles reddish, the apices darker; scape of antennae pale yellow beneath; above, the flagellum is reddish brown to dusky brown; base of pronotum, outer portion of its lobes, tegulae, largely so; axillary sclerites and basal wing veins, creamy white; fore femora postero-ventrad and mid femora ventrad, creamy white from apex to near base; posterior trochanters and femora reddish, all tibiae reddish with yellowish white dorsad; tarsi reddish brown; abdomen reddish, shining, the apical margins of tergites 1-4 whitish, that on tergite 1 the most distinct. Vestiture: dense appressed silvery pile on head and thorax, conspicuous also on femora, and in certain lights it shows as three stripes on the mesonotum, and as narrowing bands at the apex of tergites 1-4. Clypeus gently rounded outwardly, this lobe very slightly roughened and moderately gibbous; mandibles very slender, stepped down at basal third beneath rather than emarginate, and with no inner tooth; antennae subelavate, the flagellum rather fusiform, article 3 distinctly longer than 4, 12 about half again as long as thick and tapering rather sharply (collapsed?); ocelli in slightly more than a right-angle triangle. Exposed disc of propodeum much narrowed by the invading pile, opaque, and with a line-like groove that widens and flattens apically. Foretarsal rake particularly well developed for *Plenoculus*, the pale bristles extending to nearly twice the width of their respective segments; mid-tarsi with a rather dense row of long bristles; the bristles on the posterior tarsi moderate. Wing venation mostly pale testaceous, the long third submarginal cell extending apically fully as far as the marginal cell. Abdomen relatively broad; pygidium broadly triangular, the sides well carinate, the apex narrow, and the disc with a few large punctures.

MALE, allotype. Length, 4 mm. Black; clypeus, mandibles at base, scape beneath, large spot on forecoxae, femora 1 and 2 beneath and at apex, apex of femora 3, tibiae and tarsi, base of wings to well along the costal margin, creamy white; scape of antennae above and pedicel in part and base of article 3 nearly black; otherwise the flagellum is orange yellow; last tergite reddish. Clypeus gently rounded outward, no hair tuft on either side; mandibles slender, well excavate beneath, but with no inner tooth; antennae slender, subelavate, the pedicel thicker than, and fully as long as, the third antennal article which is about as wide as long and very little shorter than the fourth; the clavate portion of the antennae with no article, except the thirteenth, longer than wide, article 13 one and one-half times longer than 12 and tapering on one side from half its length; ocelli forming less than a right-angle triangle. Pronotum distinctly depressed mesad. Disc of propo-

deum narrowly exposed, depressed mesad, and with some transverse regulae; the pleurae tessellate, shining; the posterior face with a subfusiform depression. Marginal cell rather narrowly truncate, slightly exceeding the third submarginal. Abdomen smooth ventrad. Terminalia: uncal lobes sharply pointed dorsad (as facing the last visible ventral segment); a row of spines, short, heavy and spike-like, on each volsella. Vestiture: abundant silvery pile, as in the female.

HOLOTYPE, female, Borego, San Diego County, California, April 30, 1954 (M. Wasbauer), on *Croton californicus*. ALLOTYPE, male, topotypical, April 25, 1954 (P. H. Timberlake), on *Croton californicus*. PARATYPE, 1 male, topotypical, April 25, 1954 (M. Wasbauer), on *Croton californicus*. All three specimens are in fine condition.

DISCUSSION. *Plenoculus boregensis* belongs nearest the *Pl. cockerellii* group, although the terminalia of the male of *Pl. boregensis* are quite different. I consider this species our finest example of *Plenoculus*. The yellow tegumentary band on the pronotum of the female seems distinctive among wasps of this genus.

***Plenoculus boregensis perniger* Williams, new subspecies.**

MALE, holotype. About 3 mm. long. Head, thorax, and abdomen shining black. Mandibles blackish at base, thence reddish; antennae black, femora black, tibiae with some creamy white, all tarsi, except apex of last article, pale; venation of forewings generally dark testaceous, paler at base; the very tip of abdomen slightly reddish. Clypeus rounded out mesad, and except for its thick shining rim it is roughened. Mandibles not slender, slightly crooked, with a very slight notch within. Antennae thick, subclavate, article 3 as long as the pedicel and narrowed basad, article 4 very slightly shorter than 3, article 13 tapering and a little longer than $1\frac{1}{2}$ the length of 12. Ocelli forming a little less than a right-angle triangle. Vertex coriaceous; dorsulum finely and closely punctate; disc of propodeum widely exposed, finely granulate. Marginal cell of forewings rather narrowly truncate and exceeding the third submarginal cell. Some patches of silvery pile. Terminalia as in *Pl. boregensis boregensis*; the parameres with the usual fringing bristles, a row of stronger erect bristles from the concave surface, and a row of shorter volsellar bristles, lobes of aedeagus acuminate on their ventral side (facing the last visible ventral segment).

HOLOTYPE, male, Thousand Palms, Riverside County, California, April 7, 1955 (W. R. M. Mason). PARATYPES, 4 males. Two other males not considered paratypes, topotypical, early to late April, 1955 (W. R. M. Mason).

FEMALE, unknown.

DISCUSSION. This species differs from the nominate species chiefly in its black clypeus and abdomen. The largest of the series is 3.40 mm. long.

Plenoculus parvus Fox.

Plenoculus parvus Fox, 1897, Ent. News, 8:71-72. Type, female, Las Cruces, New Mexico (Cockerell, 5173).

FEMALE. The original description is as follows:

Anterior margin of clypeus subtruncate in the middle, not incised or dentate; the flagellum strongly clavate; the first joint longer than the second, dorsum and scutellum finely and closely punctured; middle segments microscopically striated, not impressed above, posterior face more distinctly transversely striated; with a deep longitudinal central furrow; legs tolerably spinose, tarsal comb feebly developed; pygidial area with large sparse punctures, not margined or carinated laterally. Black; mandibles except apex, legs except coxae and extreme tip of abdomen, red; scape beneath and tegulae yellowish; flagellum beneath testaceous; entire insect clothed more or less with silvery pubescence, especially the head in front and the thorax on sides and beneath; apical margins of abdominal segments narrowly testaceous; wings hyaline, strongly iridescent, nervures testaceous. Length 3 mm.

This is the smallest species of *Plenoculus*, and is not closely related to any of the others.

DISCUSSION. I am obliged to Dr. Karl V. Krombein for his additional findings from an examination of this unique female type, principally that there are two teeth at each lateral angle of the clypeus and that the pygidium is delimited, though rather weakly, by a carina.

Plenoculus palmarum Williams, new species.

(Figures 9, 36, 37, 71, 73, 78.)

MALE, holotype. Length, 3.8 mm. Black; antennae brownish yellow, duskiest toward base; forepart of clypeus reddish brown; mandibles, except teeth and apex, yellow; fore and mid-femora at apex beneath, all tarsi and

Figure 26. *Plenoculus boregensis*. Female. Holotype. At A, mandible, from outer side. Borego.

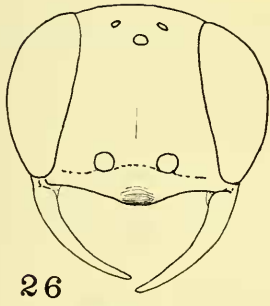
Figure 27. *Plenoculus boregensis*. Female. Mid tarsus. Borego.

Figure 28. *Plenoculus boregensis*. Male. Clypeal outline. Borego.

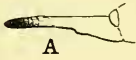
Figure 29. *Plenoculus boregensis*. A., pygidium of female; B., male, extremity of aedeagal lobes, ventral and lateral views. Borego.

Figure 30. *Plenoculus sinuatus*. Male. Allotype. Mandible somewhat inclined from side. Borego.

Figure 31. *Plenoculus timberlakei*. Male. Allotype. Mandible. To show low tooth, T, behind blade, B. Beaver Dam, Arizona.



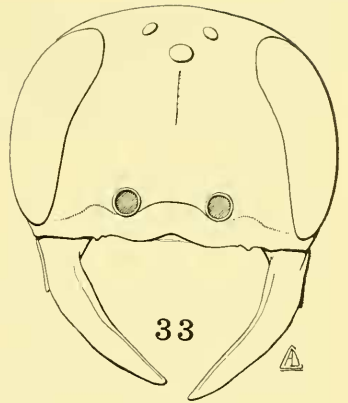
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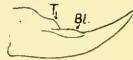
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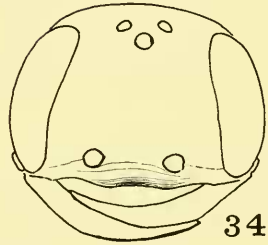
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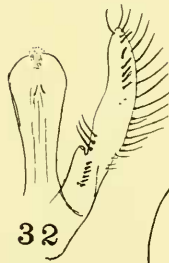
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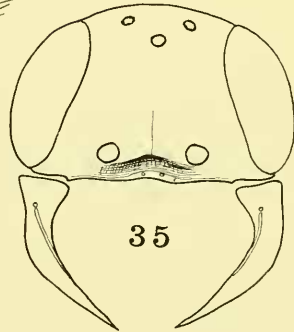
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Figure 32. *Plenoculus sinuatus*. Male. Allotype. Terminalia in part. From Borego.

Figure 33. *Plenoculus gillaspys*. Female. Type. From Williamson County, Texas. Drawn by Arthur D. Cushman.

Figure 34. *Plenoculus hurdi*. Female. Holotype. From Teotihuacan, Mexico.

Figure 35. *Plenoculus sinuatus*. Female. Holotype. From Borego.

tibiae, pale yellowish to yellowish brown; tegulae and basal venation nearly white; first three abdominal segments orange. Produced portion of elypeus subtruncate, no elypeal side whiskers; mandibles with a fang-like tooth within; antennae stout, the segments short, the thirteenth tapering; ocelli in slightly less than a right-angle triangle. Dorsulum shining, finely punctate; metapleurae above with some well-marked carinulae extending to near spiracle. Exposed disc of propodeum narrow, tongue-like, there being an imperfect bounding carina hedged in by silvery pile; there are also a few transverse and an imperfect longitudinal carina; posterior face with some fine carinulae and a narrow wedge-like cleft expanding to apex of the disc. Marginal cell very short. Abdomen smooth beneath. Lateral lobes of the aedeagus somewhat cuneate beneath, and apically above are provided with a tuft of bristles. The pile is silvery and abundant.

FEMALE, allotype. Length, 4 mm. Body shining. Black; elypeus for apical portion, mandibles except apex, scape of antennae beneath at base, and flagellum beneath, fore and middle femora beneath beyond base, creamy white; posterior femora reddish brown apically; tibiae and tarsi pale yellowish brown, but tibiae in part whitish dorsad; pronotal lobes apically, tegulae, axillary sclerites, and base of wings, creamy white; venation testaceous, abdomen entirely red; legs with spines on the palest areas whitish, otherwise spines and spurs pale brown. Head rather wide; produced portion of elypeus gently lobed, narrowly rimmed and with three teeth on each side, the innermost tooth quite small; mandibles with a fang-like tooth within at base of blade; antennae moderately stout, article 3 slightly longer than 4, article 12 gently tapering; ocelli in about a right-angle triangle. Dorsulum with close punctures. Exposed disc of propodeum narrowing from base, and with two longitudinal carinulae and some shorter basal ones; pleurae finely reticulate; posterior face with its depression in its upper portion. Marginal cell rather short, exceeding the third submarginal. Disc of pygidium broadly triangular, tapering slightly at apex, its bounding carinae not strong, the disc with a few punctures. Vestiture silvery pile in the usual places.

HOLOTYPE, male (Citrus Experiment Station, Riverside), Palm Springs, Riverside County, California, April 24, 1938 (P. H. Timberlake), flying over ground. ALLOTYPE, female, Borego, San Diego County, April 29, 1955 (F. X. Williams). PARATYPES, 2 males, Borego, April 29, 1954 (P. H. Timberlake), on *Euphorbia polycarpa*; 1 female, Borego, April 27, 1954 (P. D. Hurd). Other specimens not considered paratypes: 1 female, Blythe, Riverside County, April 24, 1955 (W. R. M. Mason); 3 males, Pinto Wash, Imperial County, California, April 28, 1958, and 12 males and 4 females, topotypical, May 5, 1958 (F. X. Williams), all at plants of *Euphorbia polycarpa hirtella*.

DISCUSSION. This small, stoutly-built species has the labrum gently bilobed in both sexes. It is evidently related to *Pl. parvus* Fox, of which only the female is known. The abdomen of *Pl. palmarum* is entirely red, and there are three teeth on either side of the low clypeal lobe, while in *Pl. parvus* there are but two such on either side.

Plenoculus propinquus FOX.

(Figures 1, 46, 55, 56, 81, 82.)

Plenoculus propinquus FOX, 1893, Proc. Acad. Nat. Sci. Phila., 45:537-538. Female, Colorado. Ashmead, 1899, Psyche, 8:337-339. Male and key to spp.

Plenoculus propinquus var. *rufescens* COCKERELL, 1898, Proc. Davenport Acad. Sci., 7:144. Reported from Arizona, California, Colorado, New Mexico, Idaho, and now from Nevada, Oregon, Washington, and Utah.

SPECIMENS EXAMINED: CALIFORNIA—KERN COUNTY: Randsburg, 1 male, May 1, 1952 (R. M. Bohart). Pumpkin Center, 1 male, July 30, 1956 (E. I. Schlinger). LASSEN COUNTY: Halleluja Junction, 1 male, July 4, 1951 (R. C. Beehtel); 3 females and 1 male, July 11, 1957 (R. M. Bohart). MONTEREY COUNTY: *San Lucas*, 1 male, August 20, 1933, on flowers of *Eriogonum gracile* (P. H. Timberlake). LOS ANGELES COUNTY: Clairmont, 3 females "PomC" (Baker). Glendale, 1 male, June 8, 1952 (E. I. Schlinger); 2 miles east of Lancaster, September 14, 1956 (E. I. Schlinger). ORANGE COUNTY: Yorba Linda, 1 female, August 15, 1920, on flowers of anise (P. H. Timberlake). RIVERSIDE COUNTY: Banning, 1 male, June 26, 1952 (J. W. MacSwain). Four miles east of Eden, 1 male, April 17, 1937, on *Larrea divaricata* (P. H. Timberlake); Riverside, 8 females and 3 males, distributed in April, June, July, September, and October, and the years 1927, 1928, and 1929, on *Euphorbia marginata*; 4 males and 3 females, comprising 6 specimens collected in June and 1 in September, during the years 1926, 1927, 1932, and 1941, on *Eriogonum gracile*: 1 female and 1 male, September, 1924, on annual *Eriogonum*; 1 female digging in loose soil. All collected by P. H. Timberlake; 3 females, August 7 and 10, 1956 (J. C. Hall and E. I. Schlinger). SAN BERNARDINO COUNTY: One mile east of Cajon Junction, 8 males, August, 1956 (E. I. Schlinger). VENTURA COUNTY: Santa Paula, 3 males, June 5, 1927, on or near ground (P. H. Timberlake). COLORADO—ALAMOSA COUNTY: Great Sand Dunes, 6 females, July 20-21, 1954 (H. E. and M. A. Evans). One female, No. 2276 Colorado; Boulder, 1 female, August 5, 1908; 1 male, August 4, 1908 (S. A. Rohwer, Det. S. A. Rowher). Collections U. S. National Museum. Limon, 1 female, August 25, 1951 (R. R. Dreisbach). NEVADA—CHURCHILL COUNTY: Fallon, altitude 4,000 feet, 4 males, May 29, 1930 (E. L. Bell), Acc. 30540, American Museum of Natural History, Minden, 2 females, August 24, 1952 (R. M. Bohart). WASHOE COUNTY: Sparks, 1 female, July 18, 1953. OREGON—DESCHUTES COUNTY:

Tumalo Reservation, near Bend, 2 males, June 22-23, 1954 (E. I. Sehlinger). UTAH—North fork Duchesne River, 1 female, July 13-14, 1927 (Cornell University Lot 542, sub. 305). MORGAN COUNTY: Pine View, Ogden Canyon, 1 female, July 21, 1922 (E. P. Van Duzee). WASHINGTON—GRANT COUNTY: Columbia River, near Vantage, 1 male, August 27, 1954 (H. E. and M. A. Evans).

DISCUSSION. The female of *Pl. propinquus* averages about 6 mm. long. It is black or with the basal part of the abdomen reddish, and the anterior tibiae in front yellowish brown. The elypens is deeply cleft mesad, almost with a stoved-in effect. The disc of the propodeum is finely granulate, with a few carinulae and a shallow median sulcus. The male has a rather gibbous elypens, often shallowly cleft mesad or bluntly produced there, and its color is more or less pale yellowish or old ivory and sometimes sharply dark at the extreme base. With rare exceptions the scape is dark beneath. The 2-3 stout volsellar thorns appear to be its best character.

Plenoculus deserti Williams, new species.

(Figures 85, 87.)

MALE, holotype. Length, 4 mm. Black; disc of elypens anteriorly yellowish red; mandibles same color except base and apex; no pale ventral stripe on scape; a stripe on fore tibiae, on fore tarsi generally, a rather obscure stripe behind on the posterior tibiae, and an obscure basal and apical mark on middle tibiae, all pale dull yellowish; middle and posterior tarsi brownish, tegulae yellowish; venation testaceous, the costa and other veins forming the marginal cell, darker; abdomen orange red. Produced portion of elypens with acute lateral angles, the low wide median lobe polished and somewhat downcurved apically; a pale elypeal tuft far to either side; mandibles excavate beneath and with a strong tooth within; antennae rather slender, articles 3 and 4 subequal, 13 curved on one side; frons and vertex subopaque a line forward from anterior ocellus, the ocelli forming barely less than a right-angle triangle, the space between the fore ocellus and each posterior one tumid. Dorsulum closely punctate, the meso- and metapleurae shining, the mesopleurae beneath with a small tubercle; disc of propodeum subopaque, broad and subtruncate, bounded apically by a curved carina, the disc is reticulate and with fanning and transverse carinulae, the median trough widens apically and is polished there, propodeal plenum shining and very finely striate, posterior face shining, transversely striate and with a broad subcordate depression. Abdomen with very fine reticulations. Aedeagus of the *Pl. davisii* type, but with about 8 strong volsellar spines. Vestiture moderate silvery pile.

FEMALE, allotype. Length, 5 mm. Head and thorax generally subshining, the punctation finer than in the male. Black, the clypeus reddish except at base, only the posterior tibiae with a pale dirty yellow stripe posteriorly, tarsi largely brownish; venation as in holotype; abdomen reddish with a darker ill-defined median blotch on tergite 2. Produced portion of clypeus subtruncate, mostly bare and shining with a very few large punctures, strongly emarginate and rather depressed mesad, the margin sloping down from this emargination and provided with an angle and two teeth at each side; mandibles stout, emarginate beneath and toothed within; antennae rather slender, segments 3 and 4 subequal, the slightly reddish segment 12 slightly longer than segment 11; ocelli forming very little less than a right-angle triangle, the line forward from the anterior ocellus about as long as the diameter of that ocellus, the space between the fore ocellus and each posterior ocellus rather tumid; head texture subcoriaceous. Length of spines of the fore tarsal comb up to about 1.3 the thickness of the segment from which they originate. Disc of propodeum generally opaque except the apical part of the very shallow median trough, and with very fine recurved striae; propodeal pleurae shining with exceedingly fine striate-reticulate surface; posterior face shining, with a V-shaped depression. Abdomen with tergites showing very fine reticulations and the usual strong punctures on the apical ones. Disc of pygidium subtriangular, not pinched apically, the sides being nearly straight, the discs with rather sparse though strong punctures having the effect of roughening its surface.

HOLOTYPE, male, in good condition, Borego, San Diego County, April 20, 1955 (F. X. Williams). ALLOTYPE, female, topotypical, April 2, 1953 (P. D. Hurd). PARATYPES likewise from Borego are, 2 males, April 25, 1954 (P. D. Hurd), on *Croton californicus*; 1 female, April 9, 1955 (F. X. Williams); 3 females, March 15, 1957 (F. X. Williams). Specimens not regarded as paratypes are, 1 male (with clypeus and mandibles black), Picaecho Pass, Arizona, September 13, 1954 (P. H. Timberlake), on *Euphorbia albomarginata*; 1 male and 1 female, Thousand Palms, Riverside County, March 28 and April 25, 1955 (W. R. M. Mason); 1 male, Fish Creek mountains, 300 feet, Imperial County, California, April 20, 1955 (W. R. M. Mason).

DISCUSSION. *Plenoculus deserti* seems to be the Colorado Desert representative of *Pl. propinquus* Fox. It differs from the latter in its generally smaller size; in the male in the slightly different clypeus and in the more numerous and more spinelike volsellar armature; in the female in the more roughened pygidial disc. And admittedly, this rather weak species may be difficult to separate from some specimens of the desert *Pl. davisi* Fox.

Plenoculus boharti Williams, new species.

(Figures 40, 61, 83, 84.)

FEMALE, holotype. Length, 4.5 mm. Frons subopaque, thoracic dorsum somewhat shining. Black; mandibles widely orange mesad, legs nearly black, fore femora at extreme base in part reddish, hind tibiae suffused with orange red, tarsi obscurely brownish, tegulae testaceous apically; abdomen red with a large central black spot on tergite 1, a still larger one on tergite 2, with tergite 3 almost entirely black, and the remaining tergites blackish. Frons densely and minutely punctate, less densely so on vertex which is shining; clypeus with the disc gently convex, the anterior part shining and with some large deep punctures, the margin slightly arcuate and with four strong teeth on each side of the rather narrow median emargination; antennae subclavate, rather stout, article 3 appearing slightly longer than 4; ocelli forming very slightly more than a right-angle triangle. Dorsulum very finely punctate. Disc of propodeum short, almost coriaceous, slightly depressed and very minutely cross-wrinkled for its apical half, the pleurae with very fine longitudinal striae, shining; posterior face chiefly smooth, with a shallow subtriangular depression from the upper part of which a pair of diverging carinulae arise. Legs moderately spinose; venation rather heavy, the marginal cell ending very slightly beyond the third submarginal cell, the second transverse-cubital and the second recurrent vein interstitial in one wing, nearly so in the other wing. Abdomen broad, the tergites generally reticulate, the fifth however with the usual large punctures; pygidium of the

Figure 36. *Plenoculus palmarum*. Female. Paratype. From Eorego.

Figure 37. *Plenoculus palmarum*. Male. From Palm Springs.

Figure 38. *Plenoculus timberlakei*. Female. Head, to show dorsally interrupted preoccipital ridge.

Figure 39. *Plenoculus davisi*. Male, with red abdomen. Ocellar triangle. From Plumas County, California.

Figure 40. *Plenoculus boharti*. Female. Holotype. From Campo, California (U.S. N.M.).

Figure 41. *Plenoculus davisi*. Female. From Midland County, Michigan.

Figure 42. *Plenoculus cockerellii*. Female. From Douglas, Arizona.

Figure 43. *Plenoculus davisi*, male, with red abdomen. Abdomen, from side, to show ventral ridges or undulations. From Big Bear Valley, San Bernardino Mountains, California.

Figure 44. *Plenoculus davisi*. Male (of Fig. 43). Abdomen, from beneath, to show ridges.

Figure 45. *Plenoculus davisi*. Female. Pygidium. From Olmsted County, Minn.

Figure 46. *Plenoculus propinquus*. Female. To show bilobed labrum. From Riverside, California.

Figure 47. *Plenoculus timberlakei*. Female. To show labrum very slightly emarginate mesad.

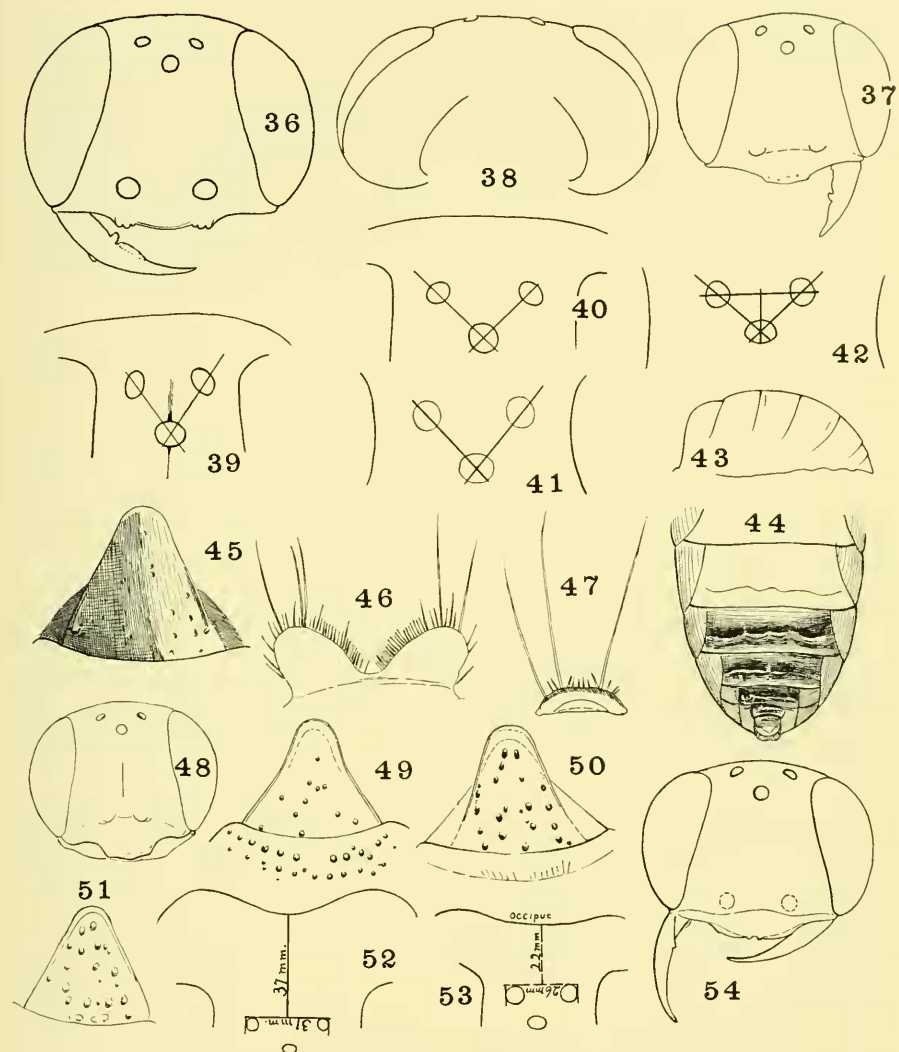


Figure 48. *Plenoculus cockerellii* (?) male. From Tucson, Arizona.

Figure 49. *Plenoculus timberlakei*. Female. Pygidium. From Beaver Dam, Ariz.

Figure 50. *Plenoculus cockerellii*. Female. Pygidium. From Douglas, Arizona.

Figure 51. *Plenoculus cockerellii*. Female. From Eloy, Arizona.

Figure 52. *Plenoculus timberlakei*. Female. To show ocellar-occipital ratio.

Figure 53. *Plenoculus davisi*. Female, with red abdomen. To show ocellar-occipital ratio. From Mill Creek, San Bernardino County, California.

Figure 54. *Plenoculus davisi gracilis*. Female, holotype. The pale clypeus has unusual dentition. Six miles west of Indio, California.

usual triangular form, not constricted subapically, shining, with rather sparse strong punctures except mesad.

MALE, allotype. Length, 5 mm. Black; mandibles distad of broad part, reddish; extreme base of fore tibiae and a stripe posteriorly on the hind tibiae and their spurs, reddish brown; tarsi dark brown; abdomen red, with a transverse blackish spot on tergites 2 and 4, beyond it is blackish; a pair of small dark spots on sternite 2. Head with exceedingly fine close punctures, more scattered behind the posterior ocelli where it is shining; clypeus with the lateral hair tufts pale brown, clypeal disc moderately convex, the anterior part roughly sculptured though shining, the produced margin only gently arcuate and armed with four strong teeth; antennae rather stout, with the scape all dark, articles 3 and 4 subequal, 13 not bent; ocelli in slightly less than a right-angle triangle; a shining, slim fusiform line from the fore ocellus to between the bases of the antennae. Dorsulum shining, very finely and closely punctate, the pleurae striato-punctate and with a polished bossed area. Disc of propodeum widely exposed, shining, longitudinally and divergently striato-punctate, the apex obtusely depressed mesad, the pleurae striato-punctate, the posterior face largely shining, transversely striate and with a V-shaped depression mesad. Venation heavy, testaceous. Abdomen gently undulate ventrad except at base, above mostly reticulate. Terminalia as in *Pl. davisi davisi* (compared with a *Pl. davisi* from Midland County, Michigan, see fig. 79); laterodistal bristles of the parameres strong, other bristles weak or wanting. Vestiture: Sparse, some of it may have been rubbed off.

HOLOTYPE, female (U. S. National Museum Collection, Type No. 58464, from K. V. Krombein Collection), from Campo, San Diego County, California, April 27 1939 (R. M. Bohart). ALLOTYPE, male, Glencliff Camp, near Buckman Springs, San Diego County, May 7, 1953 (F. X. Williams).

Thus, the holotype and allotype were taken from localities scarcely 15 miles apart. PARATYPES, California, as follows: LOS ANGELES COUNTY: Pasadena, 3 males, May 14, 1944 (K. W. Cooper), in the Karl V. Krombein Collection (U. S. National Museum Collection), 44c14. Tanbark Flat, San Gabriel Mts., 3 males, July 11, 1952; July 5 and 12, 1956 (R. M. Bohart); 1 male, July 13, 1952 (J. W. MacSwain); 1 male and 1 female, June 17, 1 female, June 20, 1956 (R. C. Bechtel). MONTEREY COUNTY: Arroyo Seco Camp, 3 females, June 6, 1956 (R. M. Bohart), 2 females, June 5, 1957 (R. M. Bohart). Other specimens not considered paratypes are: 1 male, Sequoia National Park, Tulare County, California (R. C. Bechtel), and 1 male, Samuel Spr., Napa County, California (R. M. Bohart).

DISCUSSION. The male of *Pl. boharti* is identified by its blackish clypeal disc whose edge is multidentate, more rarely, crenulate, and emarginate

mesad much as in the female, by the entirely dark antennal scape and the red and black abdomen. The male from Sequoia National Park and the one from Samuel Springs have the hind tibiae and tarsi pale reddish.

The female, on the other hand, except for the not-altogether-constant red-and-black color pattern of the abdomen and the frequently stronger protuberant clypeal teeth, seems inseparable from females with the abdomen entirely black from the same locality, that I regard as a rather dark form of *Pl. davisii*. Associated with these "*davisii*"-type females are typical pale-marked males of *Pl. davisii*.

Plenoculus stygius Williams, new species.

(Figures 5, 62, 90.)

FEMALE, holotype. Length, 3.5 mm. Shining, the sculpture very fine. Black; mandibles except base and apex, margin of produced portion of clypeus, the legs beyond femora, yellowish brown; the tarsi in part dusker; antennae brownish beneath; tegulae brownish except at apex; apex of pygidium reddish. Head coriaceous; clypeus short, smooth and thick along middle part of margin, the dentition rather minute and consisting of three teeth on each side of the rather wide and shallow emargination; antennae subelavate; ocelli forming very slightly more than a right-angle triangle. Dorsulum finely and closely punctate; disc of propodeum coriaceous, under certain lights with minute transverse wrinkles and a shallow median trough, the pleurae polished, exceedingly fine reticulate-punctate, posterior face of propodeum nearly smooth, with an inverted tear-shaped depression. Foretarsal comb not strong, leg bristles pale. Truncation of marginal cell very narrow. Tergites under lower magnification appearing smooth, but under $\times 80$ magnification with very fine transverse striae, and with a few strong punctures on tergite 5. Pygidium triangular, very little constricted apically, the disc with a few strong punctures. The silvery pile while not generally outstanding, is conspicuous on the pronotum, mesopleurae, and above on either side of the disc of the propodeum.

MALE, allotype. Length, 3.2 mm. Much like the female but the sculpture is not quite so fine, although the propodeal pleurae appear smooth and polished under moderate magnification. In addition to the pale yellowish brown tibiae and tarsi, the clypeus is dull yellow, as is also the scape beneath, the antennae being generally dull brownish above, paler beneath. There is the usual hair tuft at each side of the clypeus that is angled laterad and with a low median lobe. Antennae subelavate; ocelli forming a little less than a right-angle triangle. Abdomen with sternal cross ridges; each volsella with five stout bristles.

HOLOTYPE, female (Citrus Experiment Station, Riverside), from Palm

Springs, Riverside County, California, May 11, 1935 (P. H. Timberlake), on *Euphorbia polycarpa*; ALLOTYPE, male, Borego, San Diego County, May 12, 1955 (F. X. Williams), on a mat *Euphorbia*. PARATYPES: 1 female, Palm Springs, Riverside County, May 11, 1935 (P. H. Timberlake), on *Euphorbia polycarpa*; 1 female, 6 miles south of Palm Springs, Colorado Desert, California, June 8, 1930, on *Eriogonum trichopodum*, and 1 male near Palm Springs, June 8, 1930, on *Croton californicus*, both specimens collected by P. H. Timberlake; 4 males, Borego, San Diego County, April 29 and May 12, 1955 (F. X. Williams); 1 male, Borego Valley, San Diego County, dunes, April 18, 1957 (R. M. Bohart). Other specimens not considered paratypes: 4 males, Borego, May 12, 1955 (F. X. Williams); 6 females and 1 male, Thousand Palms, Riverside County, California, one in March, the rest in April, 1955 (W. R. M. Mason); 1 female, Blythe, Riverside County (W. R. M. Mason); 1 female, Cronise Valley, San Bernardino County, California, April 29, 1956 (M. Wasbauer). One female, Picacho Pass, Pinal County, Arizona, September 13, 1954 (P. H. Timberlake), "flying over the ground." On the same mount as one of the California females taken by Timberlake is its prey, a small mirid bug.

DISCUSSION. Obviously this little desert dweller is closely related to *Pl. davisii* Fox, but a combination of characters, at times somewhat variable, separates it from *Pl. davisii*. The more obvious distinctions in *Pl. stygius* are its highly polished condition, the lack of any pale clear yellow markings, the more delicate clypeus dentition, the rather sac-like marginal cell, its narrow truncation that extends well beyond the third submarginal cell, and additionally in the male, the generally stouter volsellar spines.

Occasionally *Pl. stygius* has the abdomen orange red, as in the above listed female from Blythe, and the one from Cronise Valley.

Plenoculus davisii Fox.

(Figures 6, 7, 8, 12, 39, 41, 43, 44, 45, 53, 54, 57-60, 63-69, 74, 75, 76, 79, 86, 88.)

Plenoculus davisii Fox, 1893, Psyche, 6:554-555; 1893, Proc. Acad. Nat. Sci. Phila., 45:537. Male and female. Michigan, Montana.

Plenoculus abdominalis ASHMEAD, 1899, Psyche, 8:339. Male. Arizona (Prescott).

Plenoculus apicalis WILLIAMS, 1914 (1913), Kansas Univ. Sci. Bul., 8:175. Male and female. (Biol., 1. c., 207-208, pl. 30, fig. 120.) Distribution: Transcontinental in the United States. Canada, British Columbia (Vernon). Mexico, Baja California Norte; Sinaloa (Mazatlan); Durango (Nombre de Dios), Nayarit (San Blas).

The original description of this species is as follows:

Plenoculus davisii ♀.—Anterior margin of clypeus deeply incised, armed with five teeth on each side, the outer and inner tooth is generally the largest, the others being in some specimens indistinct; front very finely granulated, with a long, dis-

tinct medial impressed line, which originates in a strong fovea, before the anterior ocellus and extends down between the base of the antennae; ocelli forming a triangle; on each side of anterior portion of vertex there is a curved furrow, running from each hind ocellus to the inner eye-margin; first joint of flagellum possibly a little shorter than either second or third, which are a little longer than any of the following joints, except the last; dorsulum and scutellum with very fine, close punctures, both strongly convex; suture between dorsulum and scutellum strong; meta-thorax above very finely granulated, rather strongly furrowed down the middle, the extreme base generally with a transverse series of small fossae, sides and posterior face very finely striated; abdomen finely and closely punctured, the pygidial area triangular, with large, sparse punctures, its lateral ridges not well defined; black; clypeus, except apex, tegulae, four anterior tibiae on outer side, except apical portion, yellowish; tarsi and apical margins of the abdominal segments testaceous; wings hyaline, iridescent; nervures testaceous, apical abdominal segment more or less rufous; head, thorax and abdomen more or less covered with silvery pile, which is most dense on the face, clypeus, mesopleurae and metathorax. Length 5-6 mm.

Var. legs, except anterior tibiae entirely black.

♂. Anterior margin of clypeus slightly produced medially; antennae shorter than in the ♀ and subclavate; clypeus entirely, scape beneath, tegulae, tubercles, apex of femora, the tibiae, except inner side of the two anterior pair, and the tarsi, bright yellow. Length $4\frac{1}{2}$ -5 mm.

Agricultural College, Michigan (June and July). Collected by Mr. Gager C. Davis, to whom it is dedicated; Montana (Morrison). Coll. Amer. Entom. Society.

DISTRIBUTION. Over five hundred specimens of what I consider to be *Pl. davisii* have been examined. The great majority of these are listed here, with their distribution as follows:

ARIZONA—COCHISE COUNTY: Douglas, 1 female, August 8, 1955 (R. R. Dreisbach). MARICOPA COUNTY: Tempe, 2 males, August 3, 1917 (Cornell University, Lot 542). PIMA COUNTY: Tucson, 1 male, May 30, 1920 (F. X. Williams). Dateland, 1 female, April 12, 1955 (Butler and Werner).

CALIFORNIA—ALPINE COUNTY: Hope Valley, 4 females and 1 male, July 9 and 18, 1948 (J. W. MacSwain and P. D. Hurd). CONTRA COSTA COUNTY: Antioch, 1 male, June 4, 1949 (F. X. Williams); 1 male and 1 female, July 8, 1954 (P. D. Hurd); Danville, 2 males, June 21 and 23, 1949; 2 females, August 6 and 10, 1949 (F. X. Williams). EL DORADO COUNTY: Echo Lake, 1 male, July 23, 1955 (E. I. Sehlinger); Lake Fontanillis, 8500 feet, 1 female, July 21, 1955 (E. I. Sehlinger); two miles south of Meyers, 2 females, July 24, 1955 (E. I. Sehlinger). IMPERIAL COUNTY: Gordon's Well, 3 miles west, 1 male, July 14, 1956 (E. I. Sehlinger); Pinto Wash, 3 females and 13 males, May 5, 1958 (F. X. Williams), either on *Euphorbia polycarpa hirtella* or *Eriogonum inflatum*; Fish Creek Mts., 300 feet, 2 males, March, 1 female, April, 1955 (W. R. M. Mason). INYO COUNTY: Westgard Pass Plateau, 1 female, May 27, 1937 (C. A. Hamsher). KERN COUNTY: Randsburg, 1 male, May 1, 1921 (R. M. Bohart). LAKE COUNTY: Midlake, 1 female, May 30, 1955 (E. I. Sehlinger). LASSEN COUNTY: Bridge Creek Camp, 6 females, July 9, 1949 (J. W. MacSwain); Summit Camp, 1 female,

July 28, 1949 (P. D. Hurd); Westwood, 2 males, July 9, 1949 (P. D. Hurd); McCoy Flat, 3 females, July 8, 1949 (J. W. MacSwain and P. D. Hurd). LOS ANGELES COUNTY: Mt. Wilson Trail, Branigan, 1 female, August 10, 1915 (P. H. Timberlake); Claremont (Baker), 1 female (PemC); Chrystal Lake, 1 male, June 29, 1950 (F. X. Williams); 1 female, July 9, 1952 (R. M. Bohart); eight miles east of Lancaster, 1 male, September 1, 1956 (E. I. Schlinger); Pasadena, 1 male, May 14, 1944 (44E14) (USNM) (K. W. Cooper, Coll.); Tanbark Flat, 1 male, June 17, 1956 (R. M. Bohart). MONTEREY COUNTY: Arroyo Seco Camp, 38 males and 6 females, August 6, 1956, and June 5, 1957 (R. M. Bohart); San Lucas, 1 male, August 20, 1935 (P. H. Timberlake), on *Eriogonum gracile*. NAPA COUNTY: Samuel Springs, 1 female and 2 males, May 9, 1953 (E. I. Schlinger, R. M. Bohart); 1 female, May 28, 1953 (R. C. Bechtel); 1 female, May 29, 1953, and 1 female, May 24, 1956 (E. I. Schlinger). NEVADA COUNTY: Sagehen Creek, near Hobart Mills, 1 female, May 29, 1 male, June 25, 1954 (R. M. Bohart); 3 females, July 2 and 9, 1954 (E. I. Schlinger, R. M. Bohart); 1 male, July 25, 1956 (R. M. Bohart). PLACER COUNTY: Lake Tahoe (6225 feet), 1 female, July 15, 1949 (E. G. Linsley); Carnelian Bay, Lake Tahoe, 2 males and 1 female, July 22, 1957 (R. M. Bohart). PLUMAS COUNTY: Bucks (5070 feet), 1 male, July 23, 1937 (F. X. Williams); Joinsville, 1 female, August 26, 1956 (R. M. Bohart). RIVERSIDE COUNTY: Andreas Canyon, Palm Springs, 1 female, April 24, 1932 (P. H. Timberlake), on *Eriogonum polifolium*; Palm Springs Station, 1 female, June 26, 1952 (J. W. MacSwain); Perris, 3 miles west of, May 14, 1956 (U.S.N.M.) (U. N. Lanham, Coll.); Mt. Wilson Trail, Branigan, 1

Figure 55. *Plenoculus propinquus*. Female. From Riverside, California.

Figure 56. *Plenoculus propinquus*. Male. From Riverside. Clypeal dentition of A, male from Santa Paula, California; B, male from Eden, California.

Figure 57. *Plenoculus davisi transversus*. Female. Holotype. From Three Rivers, Tulare County, California.

Figure 58. *Plenoculus davisi*. Female. Andreas Canyon, Palm Springs.

Figure 59. *Plenoculus davisi transversus*. Female. Holotype. Mandible. From outer side.

Figure 60. *Plenoculus davisi*. Female. The mandible is worn down.

Figure 61. *Plenoculus boharti*. Female. Holotype. From Campo, San Diego County, California (U.S.N.M. collection). At A, clypeal dentition of *Pl. boharti*, male, allotype, from near Buckman's Springs, San Diego County, California; at B, is the clypeal dentition of a male paratype from Tanbark Flat, San Gabriel Mts., Calif.

Figure 62. *Plenoculus stygius*. Female. Holotype. The head has been rotated so that the lower side of the face is more forward than the vertex. From Palm Springs, California.

Figure 63. *Plenoculus davisi*. Female, with red abdomen. From Riverside, Calif.

Figure 64. *Plenoculus davisi*. Female. From Sergeant's Bluff, Iowa.

Figure 65. *Plenoculus davisi*. Male. From Riverside.

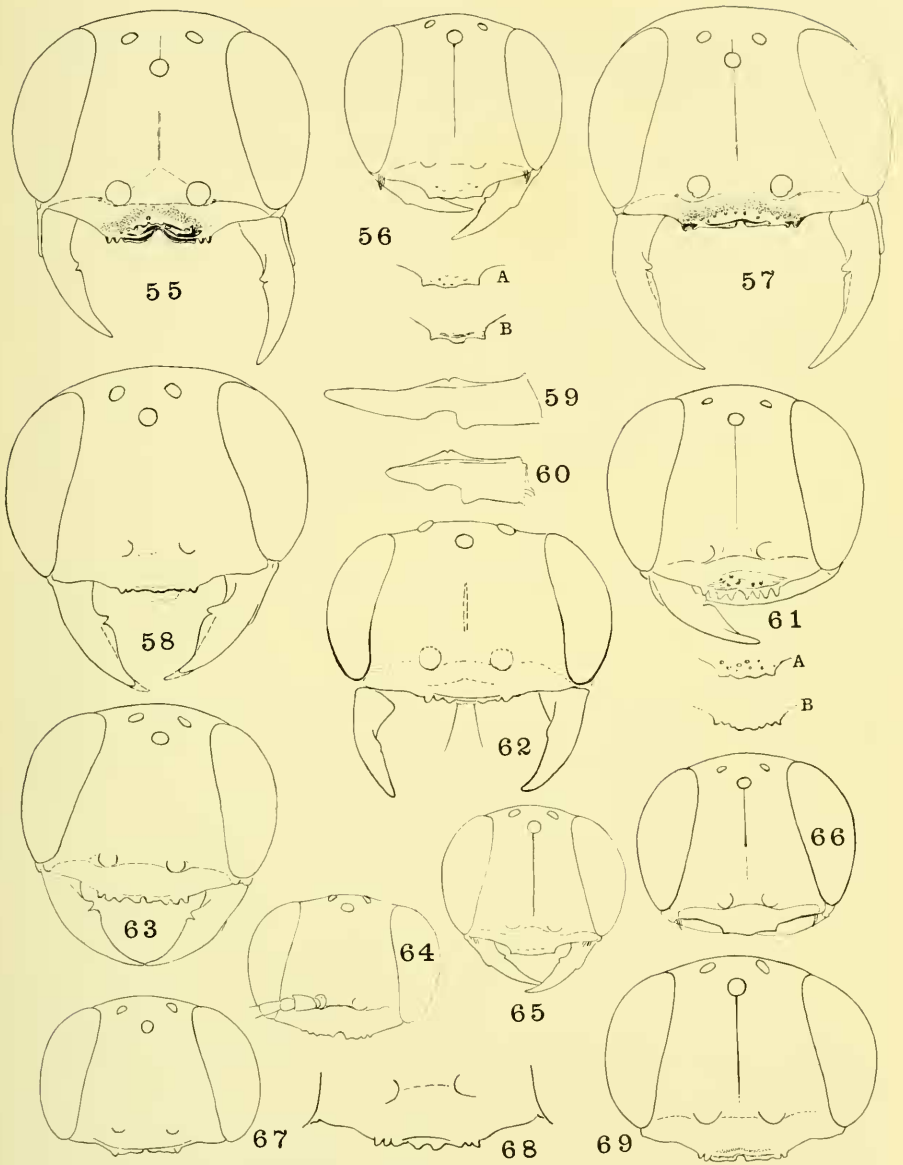


Figure 66. *Plenoculus davisi*. Male, with red abdomen. From Plumas County, California.

Figure 67. *Plenoculus davisi*. Female, with red abdomen. Clypeus probably worn down. From Imperial County, California.

Figure 68. *Plenoculus davisi*. Female. From northwestern Kansas.

Figure 69. *Plenoculus davisi*. Female. From Olmsted County, Minnesota.

female, August 10, 1915 (P. H. Timberlake); One Thousand Palms, 1 female, April 10, 1957 (P. H. Timberlake), on *Eriogonum reniforme*; Blythe, 1 female, April 24, 1955 (W. R. M. Mason); Thousand Palms, 13 males, April, 1955 (W. R. M. Mason); Riverside, 1 female, September 26, 1924, on annual *Eriogonum*, 1 female, October 15, 1926 on *Eriogonum reniforme*, 1 male, August 7, 1926, on *Helianthus annuus*, 1 female, May 14, 1926, and 1 female, September 8, 1927, on *Euphorbia albomarginata*, and 1 male, May 12, 1950, on *Eriogonum fasciculatum*, all of these collected by P. H. Timberlake; The Gavilan, 1 male and 1 female, May 31, 1937, 1 female, June 2, 1938 (P. H. Timberlake), all on *Eriogonum fasciculatum*. SAN BERNARDINO COUNTY: Big Bear Valley, 6700–6800 feet, 2 males, August 11, 1933, on *Eriogonum wrightii*, and September 14, 1934, on *Eriogonum*; Camp Baldy, 2 males, June 26, 1956 (R. M. Bohart); Dollar Line Trail, San Bernardino Mts., 1 male, July 11, 1956 (R. M. Bohart); Cronise Valley, 2 females, April 29, 1956 (P. D. Hurd, M. Wasbauer), *Heliotropus curassavicus*, *Prosopis*; twelve miles east of Mentone, San Bernardino Mts., 3 males and 3 females, July 11, 1956 (R. C. Bechtel); Mill Creek, 6000 feet, 1 female, August 28, 1936 (P. H. Timberlake); Morongo Valley, 1 male, May 7, 1939 (P. H. Timberlake), on *Eriogonum fasciculatum*; Valley of the Falls, 1 female, August 18, 1945 (P. H. Timberlake), on flowers of *Chrysothamnus*; Verdmont, 1 male, May 17, 1946 (P. H. Timberlake), on *Chorizanthe parryi*; Helendale, 1 female, May 16, 1955 (W. R. M. Mason); Redlands, 1 male (R. F. Cole). SAN DIEGO COUNTY: Borrego (or Borego), 10 males and 4 females, April 1 and 2, 1953 (P. D. Hurd); 9 males, 3 females, most with label "*Croton californicus*," last part April, 1954 (P. D. Hurd); 2 males, April 25, 1954 (M. Wasbauer), on *Croton californicus*; 4 males and 2 females, April, May, 1955, and 1957 (F. X. Williams); Borrego Dunes, 1 male, April 18, 1957; Borrego, Palm Canyon, 1 male and 1 female, April 19, 1957 (R. M. Bohart); two miles north of Warner Springs, 1 female, July 8, 1956 (R. M. Bohart), on *Croton californicus*; Green Valley, 5 miles south of Cuyamaca, 1 female, August 8, 1951 (P. H. Timberlake), on *Hugelia virgata*. SAN LUIS OBISPO COUNTY: Black Lake, 1 female, July 29, 1955, and 2 females, August 29, 1955 (R. M. Bohart). SAN JOAQUIN COUNTY: Tracy, 1 female, June 7, 1949 (J. W. MacSwain). SANTA CRUZ COUNTY: Felton, 1 male, May 15–19, 1907, 300–500 feet (Bradley), Cornell U. lot 684, sub. 39, det. J. C. Bradley, 1923; 2 females, same locality, May 20–25, 1907 (J. C. Bradley); Glenwood, 1 female, May 27, 1908 (J. Chester Bradley). SHASTA COUNTY: Hat Creek, 1 female, June 23, 1955 (J. W. MacSwain), 1 female, May 28, 1956 (J. W. MacSwain); Moose Camp, 1 female, July 14, 1957 (E. I. Schlinger); Snow Mt. Road, 1 female, June 23, 1955 (J. W. MacSwain). SIERRA COUNTY: Independence Lake, 2 females, July 17 and 20 (R. M. Bohart); 1 female, July 27, 1956 (R. M. Bohart). SONOMA COUNTY: Cloverdale, 1 male, August 26, 1953 (E. I. Schlinger). TEHAMA COUNTY: Four miles north of Paynes Creek, 1 female,

MAY 21, 1955 (R. M. Bohart). TULARE COUNTY: Three Rivers, 3 miles west of, 1 female, May 10, 1938 (P. H. Timberlake), flying over ground (= *Pl. davisii transversus*). TUOLUMNE COUNTY: Dardanelles, 1 female, June 26, 1951 (C. A. Downing). VENTURA COUNTY: Santa Paula, 2 males and 2 females, June 5, 1927 (P. H. Timberlake). YOLO COUNTY: Davis, 32 males and 50 females, collected from June 7 to September, 1953, 1956, and 1957 (Collectors: R. M. Bohart, R. C. Bechtel, J. C. Downey, A. T. McClay, and E. I. Schlinger), a female of one of these specimens is mounted with its prey, the nymph of a heteropterous bug (R. C. Bechtel, collector); Elkhorn Ferry, 4 females and 60 males, August 1, 1956 (R. M. Bohart).

COLORADO—ALAMOSA COUNTY: Great Sand Dunes, 1 female, July 20–21, 1954 (H. E. and M. A. Evans).

CONNECTICUT—East Hartford, 1 male, September 4, 1947 (H. E. Evans); Poquonoek, 1 male, June 27, 1905 (H. L. Viereck) (= *Pl. davisii atlanticus* Viereck) (Col. U.S.N.M.).

FLORIDA—Welaka, 1 male, May 1–4, 1955 (H. E. and M. A. Evans) (= *Pl. davisii atlanticus*).

IDAHO—Hollister, 1 female, No. 6, July 27, 1932, *S. pestifer* (David E. Fox) (Col. U.S.N.M.); Jerome, 1 female, June 27, 1932 ("Pole 20, trap 2, Wind Van Trap").

INDIANA—1 female, No. 2177 (1933).

IOWA—Sergeant Bluff, 3 females and 3 males, August 3, 1933 (C. N. Ainslie); Sioux City, 1 male, May 25, 1931 (C. N. Ainslie).

KANSAS—CLAY COUNTY: 4 males, August 9, 1952 (Lin). GRAHAM COUNTY: 1 male, August 16, 1912 (F. X. Williams); GRANT COUNTY: 1 female, August 18, 1952 (Acc. No. 8021, H. E. Evans, Coll.). PHILLIPS and MORTON COUNTIES: 22 males and 15 females, August, 1912 (F. X. Williams). POTTAWATOMIE COUNTY: 1 female and 1 male, June, 1950 (H. E. Evans).

MICHIGAN—CRAWFORD COUNTY: 1 male, June 24, 1953. GLADWIN COUNTY: 1 male, June 14, 1953. MIDLAND COUNTY: 1 male, June 27, 1953. OTSEGO COUNTY: 1 male, June 24, 1955. All R. R. Dreisbach, Collection. WASHTENAW COUNTY: Ann Arbor, 1 male, July 28, 1950 (U. N. Lanham); GLADSTONE COUNTY and NEWAGO COUNTY: 10 females, 1951, 1953 (R. R. Dreisbach); MIDLAND COUNTY: 1 female, 1 male, June 9, 1936 (R. R. Dreisbach) (Det. K. V. Krombein, U.S.N.M.).

MINNESOTA—Olmstead, 2 females (C. N. Ainslie) (Det. Stevens, U.S. N.M.).

MONTANA—*Plenoculus davisii davisii* Fox "type" (Det. K. V. Krombein, U.S.N.M.).

NEVADA—Fernley, 1 male, August 5, 1953 (R. M. Bohart); Mt. Rose, 6,500 feet, 1 male, June 14, 1957 (R. M. Bohart).

NEW JERSEY—Clementon, 1 male, May 24, 1902 (J. C. Bradley).

NEW MEXICO—HIDALGO COUNTY: 2 males, Rodeo, August 26, 1958 (R. M. Bohart).

NEW YORK—Ithaca, Kite Hill, 14 males, July 1 and 2 (P. P. Babi); Kite Hill Campus, Ithaca, and Ithaca, 7 males and 1 female, August 19, 1929, June 15, 1937 (P. P. Babi); June 26, June 29, 1935 (K. V. Krombein); 1 female, 6 miles from Ithaca, August 11, 1955 (with biological note) (H. E. Evans); Minetto, 3 females, June 27, 28, 1955 (H. E. Evans).

NORTH CAROLINA—Kill Devil Hills, 1 female, July 1, 1954 (K. V. Krombein) (U.S.N.M.).

NORTH DAKOTA—Beach, 2 females, July 19, 1923 (C. N. Ainslie) (U.S.N.M.) (Det. Stevens).

OREGON—Bend, 1 female, August 19, 1953 (R. M. Bohart).

TENNESSEE—Memphis, 1 male, July 16, 1914 (J. C. Bradley); 1 female, June 4, 1918 (Cornell U., Lot 684, Sub. 36 and 37, Det. J. C. Bradley, 1923, *Plenoculus davisi* ♂ Fox).

TEXAS—McDade, 1 male, June 11, 1935 (J. E. Gillaspay) (Krombein Collection, and compared by Dr. Krombein with the type of *Pl. abdominalis* Ashmead).

UTAH—North Fork Duchesne River, 1 male, July 13–14, 1927 (Cornell U., Lot 542, Sub. 305); Logan, 1 female, July 1, 1955 (R. M. Bohart); Roosevelt, 5,000 feet, 1 female, July 27, 1953 (R. Dreisbach).

WYOMING—Powder River, 1 female, August 1, 1950 (R. R. Dreisbach and K. K. Schwab).

CANADA—BRITISH COLUMBIA: Vernon, 1 female, July 14, 1947 (H. B. Leech). Tunneling in sand. The burrow stored with immature Aphidae.

MEXICO—DURANGO: Nombre de Dios, 1 male and 1 female, August 1, 1951 (P. D. Hurd). BAJA CALIFORNIA: La Paz, 1 female, October 7, 1955 (F. X. Williams). NAYARIT: San Blas, 2 males, July 20, 1951 (P. D. Hurd). SINALOA: Mazatlan, 1 female, October 7, 1955 (F. X. Williams).

DIAGNOSES OF THE SUBSPECIES *Plenoculus davisi*

Abdomen red and black; clypeus black in both sexes, almost squarely truncate in the male, usually very low subcuneate in the female, and with a median cleft and poorly developed teeth or none; in the male the aedeagus the volsellar ridge is weakly armed.....*Plenoculus davisi mojavensis* Williams, new subspecies (86, 88).

Abdomen chiefly reddish; head relatively wide; produced portion of clypeus truncate, its median emargination narrow and with two teeth far to each side (57), female*Plenoculus davisi transversus* Williams, new subspecies.

Abdomen red, clypeus pale creamy yellow, its produced portion subtruncate, the narrow median emargination with a bordering tooth (54)
*Plenoculus davisi gracilis* Williams, new subspecies, female.

Abdomen black; differs from *Plenoculus davisi* Fox in having the basal tergites reticulate instead of punctate, and the pubescence thin on the sides of the propodeum, the pile being heavier in the nominate species.....
*Plenoculus davisi atlanticus* Viereck.

***Plenoculus davisi mojavensis* Williams, new subspecies.**

(Figures 86, 88.)

FEMALE, holotype. Length, 5 mm. Rather shining. Black; mandibles reddish brown from a little before notch to near apex; fore tibiae except beneath, foretarsi, mid-tarsi, and the hind tarsi in part, brownish; venation testaceous; abdomen with first $2\frac{3}{4}$ tergites reddish orange, the remainder black. Silvery pile sparse (the insect is rather worn). Clypeus widely subcuneate, notched mesad in the small indication of a truncation, behind which it is shining and transversely tumid. Labrum deeply bilobed, as is usual with species belonging to the *Pl. davisi* complex; mandibles well notched; blade on inner side relatively short; antennae rather slender, articles 3 and 4 subequal, 12 about 1.75 longer than 11; ocelli in a right-angle triangle, an incised line anteriorly from fore ocellus. Head very finely sculptured, almost coriaceous. Pronotum not notched mesad; dorsulum very finely and closely punctate; disc of propodeum reticulate and with a few fine transverse and some basal carinulae, depressed mesad particularly toward apex, posterior face with an inbowed obcuneate area formed by a fine line from each side of the disc of the propodeum, this area hardly depressed. Venation delicate, marginal cell long, somewhat exceeding the subtruncate third submarginal; pedicel of second submarginal cell quite short. Abdominal tergites generally very finely striate-reticulate, fifth tergite with the usual sparse coarse punctures. Pygidium of the usual rather narrowly triangular form, the two carinae straight, the disc very finely tessellate and with some large coarse punctures particularly well to each side of the middle line.

MALE, allotype. Length, 4.6 mm. Marked about as in the holotype, but with tibiae and tarsi generally dull yellowish brown and the orange red of the abdomen extending into tergite 4. The sculpture is less fine than in the female. The shining black clypeus is drawn out truncate mesad, the lateral angles are sharp, the disc with moderate punctures, and there is a low median lobe from the truncation. The antennae are rather slender for the basal part, article 3 slightly longer than 4, its length nearly twice that of its expanded apical diameter, article 13 about 1.50 the length of 12; ocelli in about a right-angle triangle. Frons very finely reticulate, almost coriaceous; vertex finely reticulate-punctate. Pronotum, and mesonotum anteriorly,

slightly notched mesad, dorsulum finely and closely punctate. Disc of propodeum widely exposed, wrinkled-reticulate, the furrow shining apically, posterior face with the obtusate area poorly defined and in part finely grooved mesad. Venation as in holotype. Apical sternal rugosities strong. Terminalia: parameres as in the *Pl. davisii* group; aedeagal lobes rounded, hardly angulate on one side; volsellar ridge apparently unarmed. Vestiture: the silvery pile is not conspicuous, although the specimen is in fresh condition.

HOLOTYPE, female, ALLOTYPE male, and 4 PARATYPE males, from Apple Valley, San Bernardino County, 20-V-1955; a fifth male paratype is topotypical, 10-V-1955 (W. R. M. Mason). Apple Valley lies in the southern part of the Mojave Desert and just north of the San Bernardino Mountains. Other paratypes are from Arizona, Cochise County, Wilcox, 3 males, August 11, 14, 1958; Apache, 5 miles southeast, 1 female, August 11, 1958 (R. M. Bohart); and from New Mexico, Hidalgo County, Rodeo, 1 male, 2 females, end of August, 1958 (R. M. Bohart).

DISCUSSION. The female is best differentiated by its clypeus which at most is very greatly euneate, and cleft (86), and the male by its black clypeus.

Plenoculus davisii transversus Williams, new subspecies.

(Figures 8, 57, 59.)

FEMALE, holotype. Length, 6.5 mm. Head and thorax subopaque; general punctation fine. Black; mandibles except apex yellowish brown; clypeus reddish along margin; apex of fore femora narrowly and a good deal of hind tibiae, dull brownish yellow; abdomen reddish, somewhat darker apically.

Figure 70. *Plenoculus cockerellii*. Male. Aedeagus. From Riverside County, Calif.

Figure 71. *Plenoculus palmarum*. Male. Paratype. From Borego.

Figure 72. *Plenoculus cockerellii* (?). Male. Aedeagus. From Tucson, Arizona.

Figure 73. *Plenoculus palmarum*. Male.

Figure 74. *Plenoculus davisii* (= *apicalis*). Male. Last visible ventral segment. From northwestern Kansas.

Figure 75. *Plenoculus davisii* (= *apicalis*). From northwestern Kansas.

Figure 76. *Plenoculus davisii* (= *apicalis*). Male. Antenna. From northwestern Kansas.

Figure 77. *Plenoculus timberlakei*. Female. From Palm Springs.

Figure 78. *Plenoculus palmarum*. Male. Disc of propodeum.

Figure 79. *Plenoculus davisii*. Male. Aedeagus. From Midland County, Michigan.

Figure 80. *Plenoculus cockerellii*. Female. Fore tarsal comb. From Douglas, Ariz.

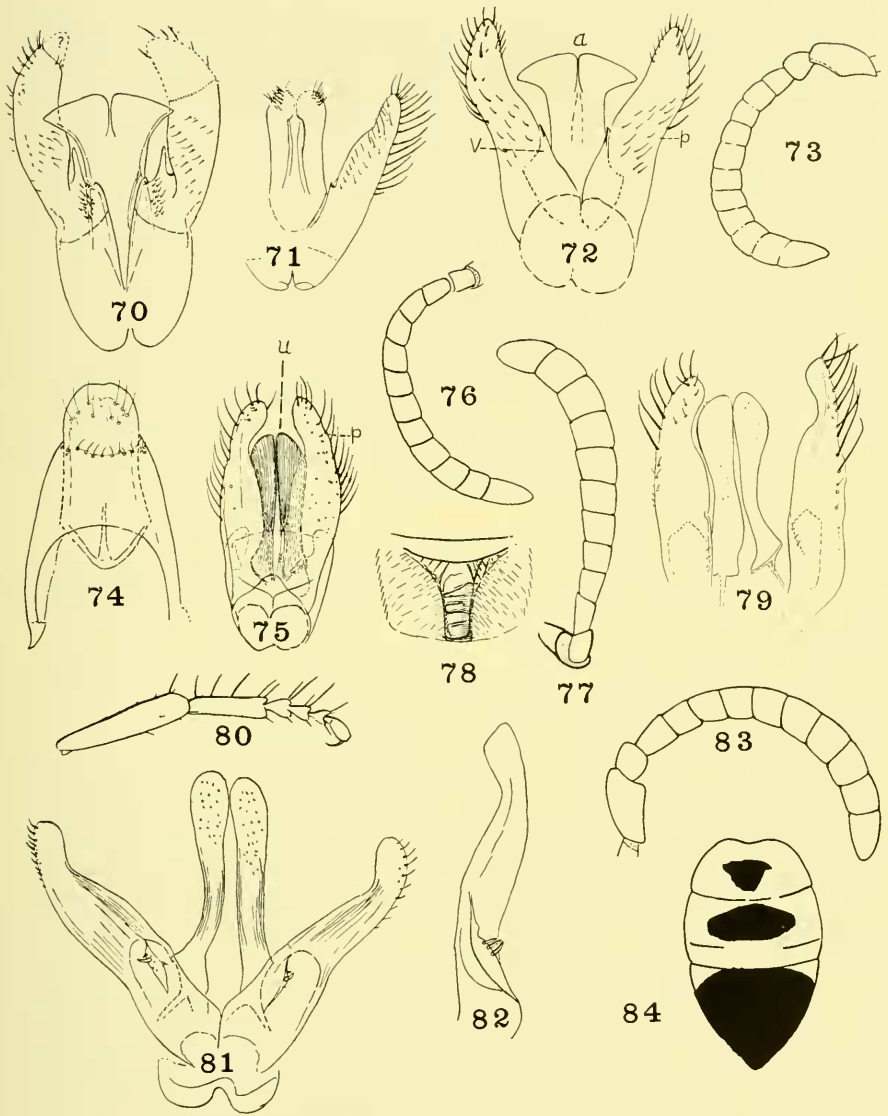


Figure 81. *Plenoculus propinquus*. Male. Aedeagus. Note the larger and the smaller volsellar tooth. From Santa Paula, California.

Figure 82. *Plenoculus propinquus*. Male. One paramere, to show three volsellar teeth. From Nevada.

Figure 83. *Plenoculus boharti*. Female. Holotype. From Campo, San Diego County, California.

Figure 84. *Plenoculus boharti*. Female. Holotype. To show dorsal abdominal pattern. White representing the red coloration.

Produced portion of clypeus truncate, with a narrow median emargination and two teeth far to each side, the clypeus short, its smooth anterior portion bordered by some large punctures; antennae rather slender, article 3 longer than 4; ocelli in a right-angle triangle, the smooth area between the posterior ocelli and the compound eyes shining. Disc of propodeum with basal fanning carinae and some recurved transverse wrinkles; the pleurae generally, very finely longitudinally striate; posterior face of propodeum shining about the V-shaped depression, elsewhere finely transversely striate. Fifth tergite rugosely punctate except apically. Pygidium rather narrowly triangular, with scattered strong punctures. Vestiture of silvery pile.

HOLOTYPE, female (Citrus Experiment Station, Riverside), three miles west of Three Rivers, Tulare County, California, May 10, 1938. Flying over ground (P. H. Timberlake). PARATYPE, 1 female (U. S. National Museum), three miles west of Perris, Riverside County, California, May 14, 1948 (U. N. Lanham). This specimen is in fine condition and agrees well with the holotype.

DISCUSSION: The relatively wide head of *Pl. davisi transversus*, the character of the clypeus and the relatively slender mandibles are its important characters.

Plenoculus davisi gracilis Williams, new subspecies.

(Figure 54.)

FEMALE, holotype. Length, 4.8 mm. Black; generally shining, finely sculptured; mandibles except apex, clypeus, scape beneath, tegulae, axillary scelerites, venation at base, fore femora beneath at apex, tibiae above, pale creamy yellow, tibiae beneath and tarsi generally, pale brownish; flagellum beyond base yellowish brown beneath; abdomen red. Produced portion of clypeus subtruncate, generally quite thin, median emargination narrow, with a tooth bordering either side; mandibles slender, with a strong tooth; psammophore fairly strong; antennae rather stout, articles 3 and 4 subequal, article 12 tapering obliquely; ocelli in slightly less than a right-angle triangle, each posterior ocellus about $1\frac{1}{2}$ times its diameter from the compound eye. Exposed disc of propodeum broadly tongue-shaped, very finely and shallowly reticulate, median furrow short, weak, pleurae and posterior face delicately reticulate, depression on posterior face rather wide. Tarsal comb strong; marginal cell extending well beyond third submarginal. Pygidium broad, slightly constricted apically and with very few punctures. Vestiture: rather dense silvery pile on head and thorax; bristles pale to silvery.

HOLOTYPE, female, 6 miles west of Indio, Riverside County, California, April 30, 1949 (E. G. Linsley, J. W. MacSwain, and R. F. Smyth), *Melilotus*.

The pale clypeus and the clypeal dentition are its chief subspecific characters.

Three other specimens somewhat resemble this subspecies in their somewhat darker and more straight-edged clypeal projection, but they are regarded as aberrant forms of *Pl. davisii* with the abdomen red. Two of these specimens are from Cronise Valley, San Bernardino County, California, the third is from Borego Valley, San Diego County.

***Plenoculus davisii atlanticus* Viereck.**

Plenoculus atlanticus VIREECK, 1902. Ent. News, 13:74. ♂. N. syn.

Plenoculus davisii atlanticus VIREECK, changed status. (See Synoptic Catalog Hymenoptera of North America North of Mexico, under direction of Muesebeck, Krombein, and Townes, 1951:941.)

Plenoculus davisii Fox of Catalog, in part. *Pl. atlanticus* not a syn. (*teste* Krombein, 1955. Ent. Soc. Wash. Proc. 57:146). (See also First Supplement 1958:187, under direction of Dr. Karl V. Krombein, to above Catalog, 1951.)

Dr. Krombein (*l. c.*, 1955) has shown that *Pl. atlanticus* is a valid subspecies. It ranges from Connecticut south to North Carolina; it occurs in Florida, and is also found in Texas (McDade).

Plenoculus davisii atlanticus Viereck differs most importantly from *Pl. davisii davisii* Fox in that the silvery pubescence delimiting the propodeal area is very sparse (usually quite dense in the nominate race), the two basal tergites are reticulate in *Pl. davisii atlanticus*, very commonly punctate in our eastern *Pl. davisii davisii*, and there are transverse arched carinae on the posterior two-thirds of the disc of the propodeum in *Pl. atlanticus* and which are lacking in the nominate race.

I am indebted to Dr. Karl V. Krombein for this data which he secured in the first place in comparing *Pl. atlanticus* Viereck type male with *Pl. davisii* Fox (2 paratypes), in the collection of the Academy of Natural Sciences of Philadelphia.

At least in the Far West, most specimens of *Pl. davisii* that I have seen have the basal tergites reticulate or tessellate, and often with some very fine cross striations, but with the silvery pubescence moderately well to very well developed on the sides of the disc of the propodeum.

NEW SYNONYMY

***Plenoculus abdominalis* Ashmead.**

Plenoculus abdominalis ASHMEAD, 1899, Psyche, 8:339, ♂. From Prescott, Arizona.

From Ashmead's description and from the study of a male specimen that was compared with the type of *Pl. abdominalis* by Dr. Krombein, and

loaned to me, I have concluded that *Pl. abdominalis* is merely a color phase of *Pl. davisii davisii*; such color phases commonly occur in the Colorado Desert, and elsewhere in the two Sonoran Zones.

Plenoculus apicalis Williams.

Plenoculus apicalis WILLIAMS, 1914 (1913), Kans. Univ. Sci. Bul. 8:175. ♀ ♂ Kansas.

So also have I made this purported species of *Plenoculus* a synonym of *Pl. davisii davisii*. The writer has examined Kansas specimens taken by Lin (1952) and Evans (1950, 1952), and these, together with the specimens collected by me in 1912, show that in the same general region in Kansas what has been called *Pl. apicalis* range in color of abdomen from chiefly reddish to almost wholly black.

My description of this wasp from Kansas would apply equally well to some of the California specimens of *Pl. davisii davisii*.

OLD WORLD SPECIES

Plenoculus tadhika (Gussakovskij).

Parlovskia tadhika GUSSAKOVSKIJ, 1935, Trav. Fil. Acad. Sci. URSS, Tadjikistan, 5:424.

This Transcaspiian (U.S.S.R.) species is represented by a single male specimen. From Gussakovskij's two figures and his description in Latin, it corresponds pretty well to *Plenoculus*, although the venation of the hind wings seems not typical for the genus.

I am not familiar with Gussakovskij's genus *Ptygospher* with which he likens *Parlovskia*.

Plenoculus beaumonti Andrade.

Plenoculus beaumonti ANDRADE, 1957, Mem. e Estudos Mus. Zool. Univ. de Coimbra, No. 247:2-7, Figs. 1-9. Male and female. Portugal, Setúbal district (Andrade): Albufeira Lagoon (Andrade). Spain (Cadiz province): Chiclana (Beaumont).

This species belongs in the *Pl. davisii* group. In the female of *Pl. beaumonti* the "Median sclerite of the clypeus widely emarginate, its anterior edge with three teeth at each side (fig. 1); . . .". This emargination is angular rather than rounded. The male has the "Paramera of the genitalia with a cluster of spines below (fig. 5) . . ."

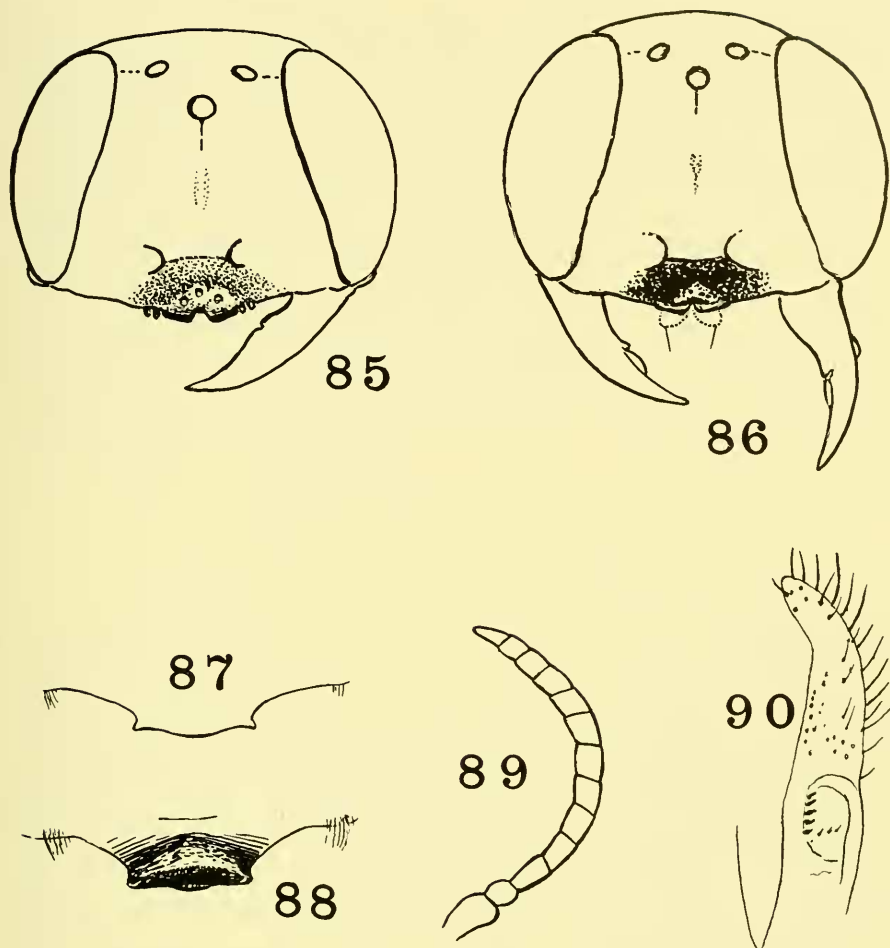


Figure 85. *Plenoculus deserti*. Female. Paratype. From Borego Desert, Calif.

Figure 86. *Plenoculus davisi mojavensis*. Male. Holotype. Apple Valley, San Bernardino County, California.

Figure 87. *Plenoculus deserti*. Allotype. Male. Clypeal production. Borego.

Figure 88. *Plenoculus davisi mojavensis*. Paratype. Male. Apple Valley.

Figure 89. *Plenoculus cockerellii*. Male. Antenna, from side (free hand), La Paz, Baja California, Mexico.

Figure 90. *Plenoculus stygius*. Allotype. Male. One paramere showing 5 heavy volsellar spines. Borego Desert.

BIOLOGY OF *PLENOCULUS*

Not much has been recorded on the habits of *Plenoculus*. In California, where the writer is best acquainted with these wasps, both directly and through the collections of other entomologists, they are most abundant in the spring in desert and semidesert regions, particularly when there have been sufficient well-timed rains to ensure an abundance of plant growth. Autumn rains may also bring out these wasps. *Plenoculus* species patronize many kinds of flowers, of which those of *Eriogonum* spp., *Croton californicus*, and the prostrate or decumbent little *Euphorbia polycarpa* var. *hirtella* and *Euphorbia albomarginata* seem the most important. Among other wasps associated with *Plenoculus*, particularly as observed on the euphorbias, are species of *Solierella*, the spider-hunting little *Nitelopterus*, *Tachyspher*, and some of the Nyssoninae. Thus, the entomologist, in collecting the desired wasps on the euphorbias, may assume a very lowly posture, even to seating himself on the sand in the heat of the desert sun before one of these plants to secure the wasp visitors. It is important to obtain good series of these wasps both at flowers and at their nesting sites so that both sexes are represented, for the association the sexes may otherwise be difficult.

Occasionally *Plenoculus* females are captured with their prey, as noted in the following records:

Plenoculus stygius Williams, new species. A female taken by P. H. Timberlake in the Colorado Desert, California, had a small mirid bug as its prey. This is mounted with the wasp.

Plenoculus davisii Fox. A female taken by R. C. Beehtel, in Davis, Yolo County, California, had a quite small heteropterous bug as her prey which is mounted on the same pin with the wasp.

Plenoculus davisii Fox. A female taken by Hugh B. Leech, at Vernon, British Columbia, was noted tunneling in the sand. The burrow was found to be stored with immature aphids.

Plenoculus cockerellii Fox. A female wasp carrying a small caterpillar resembling a pyralid was collected by P. H. Timberlake at Twenty-nine Palms, Riverside County, California, September 5, 1946. At La Paz, Baja California, Mexico, October 8, 1955, I found a loose colony of several dozen of these little wasps along a road a few miles from town. The area occupied was about 6×20 feet of a shallow sandy ditch. Here were some low plants, including a small *Euphorbia*. Many *Pl. cockerellii* females were digging their burrows in the gritty sand, and they showed great energy in throwing out the sand behind them. Some five or six of the wasps were seen flying to their burrows, each with a slender inert pyralid caterpillar held longitudinally beneath her body so that the prey projected fore and aft. A burdened wasp would alight immediately before her burrow, deposit the caterpillar, enter the tunnel, turn about therein and emerge to drag in the caterpillar. Several

of these slim little moth larvae were secured. They were somewhat reddish, striped, and with a conspicuous cervical shield, and suggested relationship with the caterpillar carried by a *Pl. cockerellii* female at Twenty-nine Palms, Riverside County, and taken by Mr. Timberlake, I did not succeed in digging out any of the wasps' burrows. Four of the relatively small male wasps were taken as they flew after the females or perched nearby. Small tachinid and bombyliid flies showed interest in the nesting activities of these wasps.

Plenoculus davisii Fox (= *Pl. apicalis* Williams). In Phillips County, Kansas, during late August, 1912, I observed some of these wasps nesting in a sandy spot, and storing their burrows with mature as well as immature capsid bugs, probably *Psallus seriatus* (Reuter), that were easily carried on the wing. The nest holes were left open while the wasps were afield. The nests apparently contained several cells, each of which contained several paralyzed bugs.

GENERAL COMMENTS ON *PLENOCULUS*

The study of the systematics of *Plenoculus* presents difficulties. Perhaps the most obvious of these is the variation in form and detail, particularly in the female, of the anterior part of the elypeus, the variation in the terminalia of the male (those of the female were not studied), and the presence of population groups that seem hardly meriting of subspecific rank. Size and color may be useful in helping determine species, but they are not wholly reliable. The female disc of the pygidium (sixth tergite) may vary somewhat in the same species, and its form and punctuation is a useful diagnostic character in only a few species, and the male genitalia, to the extent they have been studied by me, serve to separate groups rather than species. Sculpture has a useful purpose in classification but, as in the genus *Solierella*, it must be used with caution.

Data up to the present show that *Plenoculus* is poorly represented in the Old World (Portugal, Spain, and Transcaucasia in the U.S.S.R.). In North America, *Plenoculus* is transcontinental in the United States, and ranges northward from at least the southern part of Canada (one specimen from Vernon, British Columbia, others from states bordering on Canada) to well into the tropics of Mexico. Southwestern United States, with emphasis upon the tolerably well-known California deserts, appears to be the area of their greatest development. Of the fourteen species of *Plenoculus* which we have recognized for the United States, only the transeontal *Pl. davisii davisii* Fox and its subspecies *Pl. davisii atlanticus* Viereck occur east of the Mississippi River, while but four others reach or nearly reach to the Rocky Mountains. These four are *Pl. propinquus*, *Pl. parvus*, *Pl. gillaspyi*, and *Pl. cockerellii*. The remaining ten species, and four subspecies are chiefly desert

insects. *Plenoculus propinquus* seems less xerophytic, while *Pl. davisii*, as studied chiefly from California specimens, is abundant in the Upper and Lower Sonoran Zones and sometimes extends into the Canadian Zone of the mountains where it is sparse.

Plenoculus wasps having the abdomen wholly or in part orange red were noted chiefly in the desert regions of southern California. Desert species which on the contrary have the abdomen entirely or nearly entirely shining black are represented by *Pl. stygius* and *Pl. boregensis perniger*, the former being more prevalent. At least in the Upper Sonoran Zone, *Pl. davisii* has the abdomen more commonly orange red in the male sex; indeed, in some populations it seems to be exclusively a male character. In a population of *Pl. davisii* taken chiefly by Dr. R. M. Bohart, at Davis, Yolo County, California, most of the males have the abdomen black; the few females taken there also have the abdomen black.

Based on scanty material of *Pl. davisii*, specimens with the abdomen orange red do range eastward to the Rocky Mountains and beyond, as exemplified by *Pl. davisii* (= *apicalis* Williams) in Kansas, where there is a transition from the orange red to the black abdomen that seems to characterize this species more or less beyond this parallel.

Evidently a dry Sonoran climate is more selective in *Plenoculus* (and perhaps to a slightly lesser degree in *Solierella*, its first cousin) for an orange-colored abdomen and also lends to a greater diversity of species than does a humid climate. The exceptions to this general statement however, leave much to be explained.

BIBLIOGRAPHY

ASHMEAD, W. H.

1899. Four new species belonging to the genus *Plenoculus* Fox. *Psyche*, 8:337-339. (Includes table of species.)

BAILEY, VERNON

1905. Biological Survey of Texas (Life Zones, Reptiles, Mammals). North American Fauna No. 25, U.S.D.A. Biological Survey. (Prepared under direction of C. Hart Merriam.)

BANKS, NATHAN

1911. A tendency toward posterior erythrization in the Psammocharidae. *Proceedings of the Entomological Society of Washington*, 13:238.

BEQUAERT, J. C.

1929. Insular wasp faunae. *Annals of the Entomological Society of America*, 22:555-582. Regarding the folded winged wasps of the Bermudas, with some preliminary remarks on insular wasp faunae, on p. 558, "I am inclined to believe that the darkening of the integument is the effect of decreased insolation, owing to the increased cloudiness and the fre-

BEQUAERT, J. C.—Cont.

quency of fogs, rather than lower temperatures and higher atmospheric dampness”

COCKERELL, T. D. A.

1945. The Colorado Desert in California: Its origin and biota. *Transactions of the Kansas Academy of Science*, 48(1):1-39. Illustrated.

HALL, H. M., and J. GRINNELL

1919. Life zone indicators of California. *Proceedings of the California Academy of Sciences*, 9(2):37-67.

JAEGER, E. C.

1955. The California Deserts (Third Edition) X + 211 pp. Illustrated (with chapters by S. Stillman Berry and Malcolm J. Rogers). Stanford University Press.

KOHL, F. F.

1896. Die Gattungen der Sphegiden. *Annalen des Kaiserlich Koniglichen Naturhistorischen Hofmuseums*, 11(3):233-515.

MAYR, E., E. G. LINSLEY, and R. L. USINGER

1953. *Methods and Principles of Systematic Zoology*. McGraw-Hill, New York.

MEUSEBECK, C. W. F., K. V. KROMBEIN, H. K. TOWNES, *et al.*

1951. Hymenoptera of America North of Mexico. Synoptic Catalog, U. S. Department of Agriculture Monograph No. 2, 1420 pp.

1958. Hymenoptera of America North of Mexico. Synoptic Catalog, U. S. Department of Agriculture Monograph No. 2, First Supplement. Under the direction of Karl V. Krombein.

PATE, V. S. L.

1937. The generic names of the sphecoid wasps and their type species. *Memoirs of the American Entomological Society*, No. 9, pp. 1-103.

VIERECK, H. L.

1916. Hymenoptera of Connecticut. Bulletin 22, Geological and Natural History Survey, V.

WILLIAMS, F. X.

1914 (1913). Larridae of Kansas. *Kansas University Science Bulletin*, 8(4).